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AN APPRAISAL OF INSTRUCTIONAL UNITS TO ENHANCE STUDENT UNDERSTANDING OF PROFIT-MAXIMIZING PRINCIPLES. APPENDIX TO FINAL REPORT.

BY- BARKER, RICHARD L.
OHIO STATE UNIV., COLUMBUS

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TWENTY-TWO OHIO HIGH SCHOOLS OFFERING VOCATIONAL AGRICULTURE TO 262 JUNIOR AND SENIOR STUDENTS PARTICIPATED IN A STUDY TO MEASURE THE RELATIVE EFFECTIVENESS OF FARM MANAGEMENT INSTRUCTIONAL UNITS DESIGNED TO ENHANCE STUDENT UNDERSTANDING OF BASIC PROFIT-MAXIMIZING PRINCIPLES WHEN USED IN TEACHING VOCATIONAL AGRICULTURE STUDENTS IN THE SCHOOL CLASSROOM. SIX SCHOOLS ACTED AS CONTROLS AND TAUGHT FARM MANAGEMENT IN THE TRADITIONAL MANNER, SEVEN ACTED AS A PILOT-BLOCK AND TAUGHT FROM THE PREPARED UNIT IN AN UNINTERRUPTED 6-WEEK PERIOD, AND NINE WERE DESIGNATED AS A PILOT-INTEGRATED GROUP TO TEACH THE SAME MATERIAL DURING A 5-MONTH PERIOD. AN EVALUATIVE POSTTEST CONSISTING OF 45 MULTIPLE-CHOICE QUESTIONS SERVED AS THE PRIMARY METHOD OF INSTRUCTIONAL UNIT EVALUATION. THE PILOT-BLOCK GROUP RECEIVED THE HIGHEST SCORES ON THE POSTTEST FOLLOWED BY THE PILOT-INTEGRATED AND CONTROL GROUPS. STUDENT UNDERSTANDING OF PROFIT-MAXIMIZING PRINCIPLES WAS SIGNIFICANTLY ASSOCIATED WITH STUDENT YEAR IN VOCATIONAL AGRICULTURE, STUDENT YEARS OF FARM EXPERIENCE, STUDENT I.Q., AND NUMBER OF TEACHERS IN THE VOCATIONAL AGRICULTURE DEPARTMENT. IT WAS CONCLUDED THAT THE PROFIT-MAXIMIZING PRINCIPLES APPROACH TO FARM MANAGEMENT INSTRUCTION GREATLY STRENGTHENED THIS PHASE OF THE VOCATIONAL AGRICULTURE CURRICULUM. THE EXTRA TEACHER PREPARATION AND TEACHING EFFORTS REQUIRED TENDED TO RESULT IN GREATER STUDENT INTEREST AND ACHIEVEMENT. THE APPENDIXES LIST PROFIT MAXIMIZING PRINCIPLES, COOPERATING TEACHERS AND SCHOOLS, CORRESPONDENCE, INSTRUMENTS, RELATED DATA, AND A BIBLIOGRAPHY. THE STUDY IS SUMMARIZED IN VT 004 155. (WB)

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AN APPRAISAL OF INSTRUCTIONAL UNITS TO ENHANCE STUDENT UNDERSTANDING OF PROFIT-MAXIMIZING PRINCIPLES

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AN APPRAISAL OF INSTRUCTIONAL UNITS TO ENHANCE STUDENT UNDERSTANDING OF PROFIT-MAXIMIZING PRINCIPLES

DISSERTATION

Presented in Partial Fulfillment of the Requirements for
the Degree Doctor of Philosophy in the Graduate
School of The Ohio State University

By

Richard Leland Barker, B.S., M. Agr. Ed.

****

The Ohio State University
1967

Approved by

Adviser
Department of Agricultural
Education

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VITA

April [illegible], 1937	Born - Lewiston, Maine
1959	B.S., University of Maine, Orono, Maine
1961-1965 . .	Teacher of Agriculture, Coe-Brown Northwood Academy, Northwood, New Hampshire
1963-1965 . .	Assistant Headmaster, Coe-Brown Northwood Academy, Northwood, New Hampshire
1965	M. Agr. Ed., University of New Hampshire, Durham, New Hampshire
1965-1967 . .	Research Assistant, Department of Agricultural Education, The Ohio State University

FIELDS OF STUDY

Major Field:

Agricultural Education. Professors Ralph E. Bender and James W. Hensel

Minor Fields:

Administration and Supervision. Professor Robert B. Taylor

Agricultural Economics. Professor Richard H. Baker

Vocational Education. Professor William B. Logan

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CHAPTER I

THE PROBLEM AND ITS SETTING

American agriculture is undergoing accelerated changes due to socio-economic, scientific and technological developments. While the number of farms and farm workers has decreased, size of operations and production per acre have increased. Greater capital requirements, narrowing profit margins, and inefficient allocation of production resources continually challenge the farmer in the understanding of the American agricultural economy. These changes have forced agricultural educators to adjust the vocational agriculture program to meet the educational needs of students bound for the technical and scientific world of agriculture. Teachers are becoming cognizant of the pressing need for improvements in teaching techniques. They realize that as a result of the rapid changes in modern agriculture the rote memorization of specific facts has become obsolete since today's facts soon become tomorrow's history.

Until recently, agricultural educators have focused their teaching on factors of production practices and procedures. More attention has been given to production per acre of farm land than to maximum returns per acre through alternative decisions. Today's economy forces the farmer to make logical, well-planned decisions based on known profit-maximizing principles of farm management.

Duis states that,

> One of the biggest problems confronting today's farmer is how to efficiently organize and use resources available to him. He need no longer farm by chance. Through efficient management, farming has become an exacting science and the desired income can be budgeted ahead of time and almost assured. Farming involves tremendous amounts of decision-making. Right decisions result in a good chance of making money while wrong decisions lead to failure.[1]

It is apparent that agricultural education should provide an increased emphasis in training for greater understanding of efficient farm management principles. The high school student must be able to realize the "why" in agricultural decision making. Many of these decisions, if properly made, could strengthen profits for a sometimes economically depressed segment of American economy. Through greater understanding of economic principles, low income families as well as all families could greatly improve their economic and productive status.

Teachers of agriculture have generally found farm management a dull subject to teach. Student interest and motivation appear to be lacking partly because of his not yet being in a decision-making setting. The lack of adequate text books and teaching materials on the high school level which deal with basic economic concepts has impaired training for entrepreneurship. In answer to a question in Nevada as to why teachers of vocational agriculture did a sporadic or partial job in providing organized instruction in farm management, Christensen found teachers to state the following:

---

[1] Harold F. Duis. "A New Approach to Teaching Farm Management is Necessary," The Agricultural Education Magazine (September, 1963), p. 51.

> Hard to motivate students! Hard to teach.
>
> Cost studies and usable information that applies to the local situation are not available.
>
> Good teaching outlines are not available.
>
> I don't know enough about it to teach it.
>
> Many teachers lack adequate training and preparation in farm management; therefore, the instruction in this important area is neglected.[2]

The responses above are not unlike those expressed by teachers of vocational agriculture in Ohio in 1966. Selected teachers were asked why they were interested in the profit-maximizing principles research project. The consensus of this group was that they were doing an ineffective job of teaching this important phase of the vocational agriculture curriculum and were looking for assistance on how to improve. They found farm management uninteresting to both themselves and to their students. They felt a real need for a central core to their instruction to make it more meaningful and useful for the student in training him in basic agricultural decision making.

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[2] Howard Christensen. "A Contest Aids in Teaching Farm Management in Nevada," The Agricultural Education Magazine (September, 1963), p. 56.

As educators in agriculture look forward in search of improvements, changes must be made and new direction given to farm management instruction in vocational agriculture. Duis writes that "the production approach in teaching farmers must give way to the management approach. . . . Teaching of farm management in vocational agriculture is not new but the approach or method must be."[3] Thus, this study, based on seven profit-maximizing principles, involves the appraisal of a new approach to farm management instruction for students of vocational agriculture in Ohio.

Statement of the Problem

The problem involved in this study was one of measuring the relative effectiveness of instructional units designed to enhance student understanding of profit-maximizing principles when used in classes of vocational agriculture.

Specific Objectives

The following specific objectives facilitated the pursuit of this study:

1. To determine what technique of instruction results in the greatest level of student understanding of profit-maximizing principles.[4]

---

[3] Duis, *op. cit.*, p. 51.

[4] A list of the profit-maximizing principles is located in Appendix A.

2. To determine the relationship between student understanding of profit-maximizing principles and the following independent variables:
    a. Student year in vocational agriculture
    b. Student year in high school
    c. Student years of farm experience
    d. Student I.Q.
    e. Economics courses taken by student in high school
    f. Number of teachers in the vocational agriculture department
    g. College quarter hours of economics instruction received by the teacher
    h. Teacher having received Farm Business Planning and Analysis instruction
    i. Teacher having coordinated a Farm Business Planning and Analysis program
    j. Teacher's years of teaching experience
    k. Teacher's attainment of an advanced degree
    l. Hours of instructional time used
    m. Local grades (achieved by student).
3. To determine the effects of the independent variables upon student understanding of each profit-maximizing principle.
4. To conduct teacher evaluation of the developed instructional units of profit-maximizing principles.

Hypotheses

In the development of this study, three major null hypotheses were formulated. They were as follows:

1. There will be no significant difference among the pilot and control schools relative to level of

understanding of profit-maximizing principles as measured by a post-test.

2. There will be no relationship between the independent variables and the dependent variable of student understanding of profit-maximizing principles.
3. There will be no effects of the independent variables upon student understanding of each profit-maximizing principle.

Procedures Employed In The Study

The procedures employed in this study were designed to accomplish its purpose of measuring the relative effectiveness of the developed instructional units to enhance student understanding of profit-maximizing principles when used in classes of vocational agriculture. Techniques of instruction and influencing independent variables were identified as they affected understanding of profit-maximizing principles. Only a brief overview of procedures employed will be given here. A complete treatment is devoted to this subject in Chapter II.

Twenty-two schools offering vocational agriculture to juniors and/or seniors in Ohio were selected to participate in furnishing data for this study. Of this group six served as control schools by teaching farm management in the traditional manner while the remainder used the instructional units of profit-maximizing principles. Those schools using the developed units were divided into two groups. Seven schools as pilot-block to teach from the units in an uninterrupted sequence of time, and nine schools as pilot-integrated to use the materials in conjunction with other subject matter made up the pilot-school group.

An initial in-service orientation meeting of pilot and control school teachers was held on August 29, 1966. At this meeting the project was explained and a time table of events discussed. Later another in-service meeting was conducted with the pilot school teachers for the purpose of enlightening them to the use of the developed units. These meetings were followed by visitations at the pilot and control schools to observe and to assist with the teaching techniques used by the local teachers of vocational agriculture. The pilot schools were asked to use the inductive process of teaching for it was believed by the writer and his advisers that this method was most effective in teaching the understanding of economic principles. All participating schools were asked to conduct farm management instruction between October 17, 1966, and March 17, 1967. Post-testing took place within two weeks after instruction was completed. A matrix showing instructional periods, observation visits, and testing dates is found in Appendix F.

The writer used an evaluative instrument or post-test measuring understanding of profit-maximizing principles developed by McCormick.[5] A copy of the instrument may be found in Appendix B of this manuscript. Forty-five multiple-choice questions were included in the post-test which were designed to measure the understanding of the following profit-maximizing principles:

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[5] Floyd G. McCormick, "The Development of An Instrument For Measuring The Understanding of Profit-Maximizing Principles" (unpublished Ph.D. dissertation, The Ohio State University, 1964).

1. Diminishing physical returns
2. Diminishing economic returns
3. Fixed-variable costs
4. Substitution
5. Opportunity costs
6. Time relationships (time comparisons)
7. Combination of enterprises

The instrument was tested by McCormick in 1963 on discriminate groups of efficient and non-efficient farm operators. Later this same instrument was used by Rolloff[6] in formulating a basic design to assess the relative degree of effectiveness of instruction in farm management.

Basic statistical analysis of the objective data obtained in the pursuit of this study was performed by the Statistical Laboratory of The Ohio State University. It was punched into electronic data processing cards and analyzed by the IBM 7094 computer. The F test of analysis of variance followed by the Duncans multiple range statistic was used to determine the significance of difference among the mean post-test scores achieved by students comprising the three participating groups. Independent variables were grouped by level of measurement and subjected to the Pearson product-moment correlation r, the t and/or the F test to determine their influence upon student understanding of profit-maximizing principles pertaining to all instructional units combined and to each specific principle. Ninety-five per cent was established as the confidence interval.

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[6] John A. Rolloff, "The Development of A Model Design To Assess Instruction In Farm Management In Terms of Economic Returns and The Understanding of Economic Principles" (unpublished Ph.D. dissertation, The Ohio State University, 1966).

Teacher subjective appraisal of the units was secured by (1) the writer visiting each pilot school to (a) observe the use of and student response to the units and (b) to obtain teacher impressions of the instructional units, (2) the use of a unit evaluation survey instrument, (3) an evaluation meeting with all pilot teachers, and (4) the weekly reporting forms of "Daily Schedule of Activities."

Development of the Instructional Units

Need for the strengthening of farm business management instruction in vocational agriculture was recognized in Ohio in 1965. For this reason the writer was commissioned to assist in the development of instructional units designed to teach the understanding of basic economic principles applicable to farm business management. It was decided to base these units on the seven profit-maximizing principles identified by Floyd G. McCormick.[7] On February 15, 1966, the Departments of Agricultural Education and Agricultural Economics of The Ohio State University endorsed this decision.

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[7] Floyd G. McCormick, op. cit., pp. 29-30.

Basic planning continued with the selection of administrative staff, technical assistants, an advisory committee and supporting consultants.[8] Through the planning of these groups, the basic framework and organization developed for the writing of the instructional units. It was felt that the inductive process of teaching with the discovery approach to the understanding of economic principles was of substantial value to students of vocational agriculture. The principles approach was believed to lend ". . .itself to instruction which is directed toward the development of understanding and the ability to make appropriate application to a wide range of agricultural problems. It has long been accepted that principles should be taught with application and that the most effective teaching results when principles and application are presented in the closest association with each other."[9]

Hammonds substantiates this philosophy by stating, "A good general rule to follow in teaching is: Develop the concept before presenting the term or statement that stands for the concept. . . . The discovery of a principle for one's self is usually more effective in learning then when it is pointed out by another; it is a more vivid experience."[10]

---

[8] Names of these individuals and participating teachers may be found in Appendix C of this study.

[9] John Tull Starling, "Integrating Biological Principles with Instruction in Vocational Agriculture" (unpublished Ph.D. dissertation, The Ohio State University, 1964), p. 4.

An extensive search was carried out to develop related materials and gather information on each of the seven profit-maximizing principles. Contact was made with the Economics Department of The Ohio State University and the Department of Education at Purdue University, both of which were conducting similar studies. Neither of these contacts proved to be helpful in lending assistance in the development of instructional units for teaching profit-maximizing principles. The former study was designed as an entire course covering the broad area of economics for ninth-grade high school students. This approach demonstrated the value of structure in the teaching of economics. Although the basic concepts of inductive teaching and the discovery approach were useful, the instructional materials prepared by The Ohio State University Economics Department did not appear applicable to farm management instruction in vocational agriculture because of their broad approach to economics in general. The profit-maximizing principles approach, on the other hand, was to concentrate on the practical application of basic concepts of farm management to be used at the junior and senior level of high school.

The study conducted at Purdue seemed at first to be closely allied to the profit-maximizing principles project. However, it was found that their study involved production economics and, more specifically, the areas of value theory, marginal analysis, the laws of supply and demand, and the laws of variable proportions. In the judgment of this writer and his advisers, the Purdue approach to the improvement of farm management instruction did not meet the needs of vocational agriculture in Ohio. Their approach appeared to be too broad with little emphasis on the specific basic economic concepts.

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[10] Carsie Hammonds. Teaching Agriculture (New York: McGraw -Hill Book Company, Inc., 1950), p. 30.

Five outstanding teachers[11] of vocational agriculture within the state were employed as technical assistants to aid in the construction of the teaching materials. The format[12] and basic unit development was accomplished by these teachers under the direction of Ralph E. Bender, Department Chairman, Floyd G. McCormick, and this researcher, of the Department of Agricultural Education, The Ohio State University. The technical assistants completed their responsibilities by June 1, 1966. Their work was followed by extensive refinement and editing by the research project administrative staff and advisory committee. This work was followed by printing and compiling the instructional units into a teaching manual[13] for use by pilot school teachers. The manuals, containing 145 pages, were completed on August 26, 1966.

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[11] Names of these men may be found in Appendix C of this study.

[12] The format for instructional unit development may be found in Appendix B of this study.

Assumptions

The following assumptions are accepted by this writer as fundamental to this study. It is assumed that:

1. The seven profit-maximizing principles are the central focal point to farm management instruction in vocational agriculture.

2. The instrument used in this study was valid in measuring understanding of profit-maximizing principles.

3. Understanding of profit-maximizing principles can be measured by means of a forced choice evaluative instrument.

4. The criteria used for selecting pilot and control schools utilized in this study provided an adequate randomization.

Limitations

This study is limited by the following factors:

1. The lack of a common understanding of what should be included in farm management instruction for vocational agriculture.

2. The skill of teachers to effectively use the inductive

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[13] "Instructional Units On Profit-Maximizing Principles," A research project of The Department of Agricultural Education, The Ohio State University and Vocational Agriculture Service, State Department of Education, Columbus, Ohio.

process of the discovery approach to the understanding of profit-maximizing principles.

3. The time and ability of pilot-school teachers to understand and use the developed instructional units as designed in a block or integrated technique.

4. The number and location of the pilot and control schools.

5. The validity and reliability of information received from pilot and control schools pursuant to the independent variables.

Need for the Study

The President's Panel of Consultants on Vocational Education found a need for change in vocational agriculture. Through its 1962 study, this Committee discovered a void in farm business management instruction. It stated that "Changes should be made in existing programs to bring them more nearly into accord with present day needs. . . ."[14] One of the recommended changes was, "present restrictions should be changed to recognize that agriculture is no longer based on production alone and that vocational agricultural education should provide increased emphasis on management, finance, farm mechanization, conservation, transportation, processing, marketing the products of the farm, and similar topics."[15] This recommendation was accepted and later written into Public Law 88-210, better known as the Vocational Education Act of 1963. The 1963 Act also requires periodic evaluation of vocational programs and the instruction being offered. As a result of the new Act, an expansion of the vocational agricultural curriculum has developed. This new horizon has created a greater need for the teaching, understanding, and application of broader principles of agriculture and specifically economic principles in the area of farm business management.

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[14] U.S. Department of Health, Education, and Welfare, Office of Education. Education for a Changing World of Work. (Washington: U.S. Government Printing Office, 1963).

The recently published "Objectives of Vocational and Technical Education in Agriculture" ascertained the desirability of broad principles which support both production and non-production agriculture.[16]

Robert E. Rieck recently said, "I'm certain that teaching management can classify as a task which is relatively easy to talk about but may be difficult to do effectively."[17] Vocational agriculture teachers have found this to be true as they search for new approaches and techniques of teaching farm business management. These teachers realize that "the management of the commercial farm calls for entrepreneurship--the ability to make decisions and the willingness to accept risks. The success of the entrepreneur is determined by his ability to use his resources to achieve both monetary and non-monetary objectives."[18]

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[15] _Ibid_., p. 228.

[16] U. S. Department of Health, Education, and Welfare, Office of Education. _Objectives For Vocational And Technical Education In Agriculture_. (Washington: U.S. Government Printing Office, 1965).

[17] "The Management Factor in Commercial Agriculture: How Can It Be Taught?", _Journal of Farm Economics_ (December, 1965), p. 1449.

Fuller states that ". . .little attention has been given to the improvement of farm business management instruction in the present high school programs."[19] He suggests that production and mechanics orientated subject matter be replaced with farm business management as the central theme to the vocational agricultural program. Most agricultural educators would not go to the extreme of replacing the basic core of production agriculture with farm management as Fuller suggests, but would be likely to follow the recommendation of Glenn S. Pound, Dean of the College of Agriculture, University of Wisconsin. Pound was recently quoted as stating that, "Our curriculum emphasis (in vocational agriculture) must be more and more on principles and concepts, and less on technology and species management."[20]

A. W. Tenney, former director of the Agricultural Branch of the U.S. Office of Education, suggests that "vocational agriculture courses should be continually modernized in keeping with technological changes. Principles of farm science and management need greater emphasis."[21] Walker continues to extend this philosophy as it relates to Cooperative Extension training.[22] In discussing new directions being given in the Extension organization in the State of Virginia, he points out that management is a critical area of need. Even at the agent level he says that "A majority of the county extension agents in Virginia, like in many other states, received training in production oriented developments. They are well-versed in production technology but lack basic economic training."[23] He continues to expound that the art and science of farm management is in the understanding and use of production economic principles in decision making and application of these principles in the maximizing of profits.

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[18] E. N. Castle and M. H. Becker. Farm Business Management (New York: The Macmillan Company, 1962), p. 1.

[19] Gerald R. Fuller. "Organizing the High School Curriculum Around Farm Business Management," The Agricultural Education Magazine (September, 1963), p. 60.

[20] "Should Agricultural Students Study Farming," Crops and Soils Magazine (February, 1967), p. 5.

Training students of vocational agriculture in economics and farm business management is not an easy task to do effectively. For students to be interested in this area and for the experience to be meaningful for them it must be based on lasting principles. Instruction must serve a useful purpose to these students and must relate to their own situation. Since many students are not presently involved in economic decision making, instruction must be based on future needs and the present situation.

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[21] Vocational Education, The Sixty-fourth Yearbook of the N.S.S.E. (Chicago: The University of Chicago Press, 1965), p. 117.

[22] Harold W. Walker. "An Effective Education Program In Farm Management," Journal of Farm Economics (December, 1964), pp. 1179-1180.

[23] Ibid., pp. 1179-1180.

Farm management instructors must promote wide participation to develop thinking and understanding among the students. Lovenstein states that, "there are two sources of confusion and incompleteness which make the communication of economics difficult. One lies in the analysis itself; the second lies in the presentation of economics."[24] This also applies to farm management instruction for students of vocational agriculture. For this reason teachers need assistance in communicating with their students. "Nearly all texts comment briefly on methods in economics. . . . Yet it is highly questionable that comments on methods mean very much unless the entire text makes a conscious, methodical, and continuous demonstration of the reasoning process."[25] There remains then a need for the development and evaluation for teaching materials for the analysis of farm management and a method of presenting these materials.

After an intensive search, the writer has found no satisfactory evidence regarding the development of instructional materials or units published for basic economic principles for use in vocational agricultural classrooms. The reason for this deficiency, as judged by the consensus of leaders in agricultural education, remains to a large extent, due to the lack of teacher understanding and insufficient available instructional materials.

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[24] Meno Lovenstein, et. al. "Development of Economic Curricular Materials For Secondary Schools" (The Ohic State University Research Foundation, 1966), p. 21.

[25] Ibid., p. 22.

Therefore, if teachers of vocational agriculture are to concentrate on teaching the understanding of principles, they must have effectively designed and evaluated instructional materials as well as training in their use. Henry M. Brickell indicates that local teachers do not have the influential power nor the assistance to develop innovations in instructional techniques. However, if instructional materials are made available and the teachers are instructed and assisted in their use, they will effectively adopt them.[26] For this reason the need has arisen in vocational agriculture to develop and evaluate instructional units of profit-maximizing principles as they apply to farm business management.

The Inductive Process

Lovenstein, as previously pointed out, has indicated that analysis and presentation are of ultimate importance. For this reason the inductive approach to learning was used in the design of the new approach to farm business management. "Basically, the inductive process is reasoning from particulars to generalizations. Students all too frequently are not given opportunity for making observations and from them arriving at generalizations. The chief value of the inductive procedure is not that students arrive at 'correct' generalizations consistently, but that they often have the opportunity to employ this type of reasoning under competent direction."[27] Nicolai sees real implications for more in-depth understanding using the inductive process of learning. He furthermore is cognizant of the weaknesses within the present-day classroom setting and of teacher understanding of the inductive process. Many writers point out these weaknesses. They seem to be in general agreement that the inductive process has many merits but must be used and used well. Teaching inductively avoids rote learning. It concentrates on discovery for oneself under teacher guidance.

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[26] Henry M. Brickell. Organizing New York State for Educational Change (State Education Department, Albany, New York, 1961).

> "The primary purpose of the inductive process of teaching is to help students find, understand and state principles which have broad application to agriculture and to agricultural practices. Its use also helps students understand why certain farming practices are followed and why other practices are less desirable. It substitutes giving students a more complete understanding of a large important truth for an attempt to give students a transitory knowledge of many less important facts. Therefore, it may accomplish a most desirable end in that its use could result in teaching less and teaching what is taught much more thoroughly."[28]

Sutherland indicates that the inductive process has two major deterrents compared with four compensating advantages. The weaknesses are of a time consumption nature; that of the time required to cover subject matter and that of teacher preparation.

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[27] F. L. Nicolai, "The Application of Inductive Procedures To Selected Topics For High School Biology," The American Biology Teacher (March, 1961), p. 151.

[28] S. S. Sutherland, "More Inductive Teaching Needed," The Agricultural Education Magazine (September, 1964), p. 66.

The advantages are suggested as (a) being an inherently interesting process, (b) teachers who use it may tend to cover fewer subjects but to teach more thoroughly, (c) the teaching being centered around broad principles with broad application resulting in greater student understanding, and (d) the inductive process being a thinking process whereby students are taught to think.[29]

It is difficult to argue that the advantages of the inductive process given by Sutherland are not important to the teaching-learning process of guiding the change of behavior of students. Many educators have recognized these values for a number of years. In 1860 Herbert Spencer in his treatise, Education: Intellectual, Moral, and Physical, declared that "children should be lead to make their own investigations and draw their own inferences. They should be told as little as possible and induced to discover as much as possible."[30] Later John Dewey advocated the advantages of inductive teaching and the discovery process. He stated in his book of 1933 that "there is an innate disposition to draw inferences, and an inherent desire to experiment and test."[31] Thus the autonomy of the student has enormous importance for both motivation and conceptual growth. If these inherent elements are taken away from the student, the most potent forces for involvement in learning and his opportunity to influence the course of his learning are destroyed. These elements are not destroyed with the successful use of inductive process and the discovery approach to the understanding of principles.

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[29] Ibid., p. 71.

[30] Herbert Spencer. Education: Intellectual, Moral and Physical (London: Hurst and Company, 1860), p. 126.

[31] John Dewey. How We Think (New York: D. C. Heath and Co., 1933), p. 83.

The Discovery Approach

Discovery is an integral part of the inductive process. Thus, Bruner combines the interpretations of the majority of the writers in stating, "that discovery. . .is in its essence a matter of rearranging or transforming evidence in such a way that one is enabled to go beyond the evidence so reassembled to additional new insights."[32] Therefore, if students of vocational agriculture are equipped with experiences and observations of farm management situations and problems they may be guided in the discovery of decision making. This may, in turn, assist in the understanding of basic profit-maximizing principles with the aid of a principles technique of the discovery approach of teaching. In the discovery approach ". . .we are asking children to think and to generate questions in pursuit of discovery. This requires them to plan, to make decisions and to think creatively."[33] "The success of this procedure depends largely upon the questions asked of the students. Questions should be appropriate and timely. One basic purpose of the questions should be to create problems which students will want to solve."[34] In the design of the developed instructional units, great care was taken in structuring questions to promote student interest and participation.

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[32] Jerome S. Bruner, "The Act of Discovery" Harvard Educational Review (Winter, 1961), p. 21.

[33] Richard J. Suchman, "Inquiry Training: Building Skills for Autonomous Discovery," Merrill-Palmer Quarterly of Behavior and Development (July, 1961), p. 156.

Most writers agree that discovery in teaching involves a series of experiences and generalizations whereby one comes to understand concepts and principles. Understanding then becomes the basis for intrinsic rewards to the individual and leads him toward autonomy. "This dynamic and almost compulsive involvement of the child or adult investigator searching for answers provides the fuel for the vehicle of investigation. Without this hunger for answers there could not be scientific inquiry."[35]

Bruner has suggested that learning by discovery benefits the learner in four major ways. It (a) increases the learner's ability to learn related material, (b) fosters an interest in the activity itself rather than in rewards which may follow from the learning, (c) develops ability to approach problems in a way that will more likely lead to a solution, and (d) tends to make the material that is learned easier to retrieve or reconstruct.[36] In defense of his views Bruner points out that ". . .the principle problem of human memory is not storage, but retrieval."[37] The key to retrieval is organization and knowing where to find information. Farm management concepts, and principles that are organized in terms of a student's own interests and cognitive structure are truths that have the best chance of being accessible in memory. Thus, teachers of farm management should have available instructional units of profit-maximizing principles that will be helpful in aiding the student in organizing his study to enable him to recall and use basic concepts and principles rather than mere facts.

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[34] Nicolai, op. cit., p. 153.

[35] Arthur Carin and Robert B. Sund. Discovery Teaching In Science (Columbus, Ohio: Charles B. Merrill Books, Inc., 1966), p. 5.

The inductive teaching process of the discovery approach to understanding of principles is quite adaptable to vocational agriculture. In this age of a wealth of ever-expanding knowledge it is impossible to teach all that is desired of farm management and agricultural economics in the few short years the student spends in vocational agriculture. The Educational Policies Commission recognized this situation in stating, "No school fully achieves any pupil's goals in the relatively short time he spends in the classroom. The school seeks rather to equip the pupil to achieve them for himself."[38] The discovery approach aids in the development of the ability of the individual to become autonomous, and to help develop the heuristics of discovery and learning.

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[36] Bert Y. Kersh, "The Motivation Effect of Learning by Direct Discovery," Journal of Educational Psychology (Vol. 53; No. 2; 1962), p. 65.

[37] Bruner, op. cit., p. 31.

> "Economic concepts must not only be 'discovered'; they must also be organized. The organization of the concepts can itself be a vital part of the conceptualization of the discipline, a stimulant to effective reasoning and an essential element in the retention of analysis."[39]

If this statement by Lovenstein is true, it is obvious that the traditional ordering of concepts of farm management is inadequate. Lovenstein continues to suggest that "much attention needs to be given to the intellectual and psychological factors involved in the organization of thought."[40] Teachers of vocational agriculture should, therefore, include concepts in groupings which have the quality of providing insight into a number of implied relationships.

Concentrating On Basic Principles

The discovery approach of inductive teaching and learning leads to basic principles of farm business management. "The experimental course in the principles represents a deliberate and full use of educational philosophy and psychology addressed to three objectives; (a) the demonstration of economic reasoning; (b) the educationally meaningful grouping of economic concepts; (c) the use of the logic of economics and rhythmic education as a basis for selection and emphasis."[41] It is, therefore, believed that vocational agricultural instruction should concentrate on the principles approach to farm management if students are to learn more and better. Hammonds states that "in vocational agriculture much attention is being given to principles, concepts, values and other generalizations, and more attention will be given in the future."[42]

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[38] Educational Policies Commission. The Central Purpose of American Education (Washington, D. C.: American Association of School Administrators, NEA, 1961), p. 2.

[39] Lovenstein, et al., op. cit., p. 24.

[40] Ibid., p. 27.

The values of concentrating on principles of economics within farm business management are shared by many educators. Due and Clower state that the "relationships which result from economic analysis are economic principles. More specifically, economic principles are generalizations which express relationships among various elements of an economic system."[43] Therefore, if students are to learn to make decisions in farm management they must understand the relationships and basic profit-maximizing principles underlying the economic system of the agricultural business.

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[41] Ibid., pp. 45-46.

[42] Carsle Hammonds, "Teaching Principles, Concepts, and the Like," The Agricultural Education Magazine (January, 1964), p. 123.

[43] John F. Due and Robert W. Clower, Intermediate Economic Analysis (5th Ed.; Homewood, Illinois: Richard D. Irvin, Inc., 1966), p. 12.

Economic principles become the primary tools of farm business analysis and management. This analysis is of primary significance in indicating the consequences of alternative actions within the business and thus provides an intelligent basis for choice among the alternatives. Furthermore, economic analysis provides a guide to rational planning. Given the desired goals of the individual farm business, the utilization of economic principles allows an evaluation of various policies for efficient attainment of the goals. "Application of economic principles to existing circumstances should facilitate improved estimates of future decisions. . . . The utilization of economic principles to analyze the facts of the particular situation provides the best available basis for prediction and decision making."[44]

Understanding of principles gives students mobility from one situation to the next and from one line of thinking to another. This encourages increased learning power giving a subject dimension and perspective with greater enthusiasm. In discussing the movement of high school and college graduates of today, Dean Acker, of the South Dakota State University, points to the values of understanding basic principles:

> Most graduates of this decade will have a chance to work in a foreign country. . . . Such opportunities emphasize the value of basic principles and concepts in courses and curriculum, but even more importantly, they indicate that the curriculum must include enough experience in applying principles

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[44] Ibid., p. 18.

> and concepts to science and business situations so that students fully appreciate that such can be easily and effectively applied by him to a variety of situations.[45]

The principles approach to farm management helps the student to understand the "why" involved in the decision-making process. Mickelson states, "that a person who learns the simple what and how of a skilled situation without the basic principle of why is extremely limited educationally."[46] Students who are taught the understanding of basic principles have a better understanding of the given situation in that it is more meaningful when he has the ability to recognize it as such and to transfer these factors in a useful manner. ". . .basic principles produce results over and over again, therefore they become the essential foundation of education in agriculture and constitute the basis for making sound decisions and for the application of skills and techniques."[47]

Learning principles per se is of no value. Formulating the profit-maximizing principles in words is not indispensable in achieving application because the generalization, meaning, and usefulness is not achieved. Craig adds that through the discovery method "independently derived principles are more transferrable than those where the principle is given to the student."[48] In other words, the high school student of farm management must discover the similarity of the situations and derive the principle from them.

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[45] Duane Acker, "Objectives of Undergraduate Education and the Role of Agricultural Economics for Non-Agricultural Economics Majors," Journal of Farm Economics (February, 1967).

[46] L. F. Michelson, "Teaching Basic Principles--A Definition," The Agricultural Education Magazine (March, 1965), p. 225.

[47] C. E. Richard. "Teaching Basic Principles in Science in the Vocational Agricultural Curriculum," The Agricultural Education Magazine (January, 1964), p. 130.

In designing a manual for integrating biological principles into agriculture researchers in California stated that,

> The principles approach was selected because it lends itself to instruction for understanding, essential to the ability to make appropriate applications.
>
> . . . It has long been accepted that 'principles should be taught with application'; that teaching is most effective when these two important kinds of content are presented in the closest association with each other.[49]

It is in this same reference that instructional units were developed for teaching profit-maximizing principles at The Ohio State University in 1966.

Farm management is concerned with decision making. As new techniques are developed, the farm manager must make more and more decisions based on economics. "The skillful manager strives to make those decisions which will maximize the returns to all resources used in the farm business insofar as they are constant with personal objectives. This involves the use of the principles of economics in connection with laws which govern the growth of plants and animals, and the use of labor and machines."[50] The instructional units developed of profit-maximizing principles concentrated on this expanding decision-making process.

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[48] Robert C. Craig, "Directed Versus Independent Discovery of Established Relations," Journal of Educational Psychology (April, 1954), p. 224.

[49] California State Department of Education. Biological Principles in Agriculture. A Report of a Project Consultant Under The National Defense Education Act of 1958, p. i.

"Whichever of the evolving approaches for teaching farm business management is utilized, an understanding of basic profit-maximizing principles seems imperative."[51] In the above statement McCormick stresses the need for the use of economic principles in whatever method the local teacher may choose to teach farm management to his students. The ultimate objective of any effective method should be not only the acquisition of understanding of economic principles but also the application of them. "The more nearly a farmer succeeds in applying these principles, the greater will be his financial success."[52]

Evaluation

For students of vocational agriculture to become efficient farm and/or firm entrepreneures they must be well trained on the understanding of basic profit-maximizing principles. This study concerns itself with the appraisal of the previously mentioned instructional units designed to enhance student understanding of profit-maximizing principles. It is imperative that these units be tested and validated to measure their effectiveness before they are distributed and used by other teachers of agriculture. Therefore, this study determined the overall effectiveness of three techniques of farm management instruction and its relationship to independent variables. Without a planned and structured evaluation, little would be known of the influence of the independent variables and technique of instruction upon student understanding of profit-maximizing principles. The goal of the developed instructional units was to enhance understanding of profit-maximizing principles. Evaluation, on the other hand, is the comparison of the actual with the ideal. Without evaluation it would be uncertain as to the attainment of the ideal or the foregoing goal. Appraisal should show evidence of the influences of inductive teaching using discovery approach and the principles technique to farm management instruction.

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[50] H. C. M. Case, Paul E. Johnson, Wilbur D. Buddemeier. Principles of Farm Management (Chicago: J. P. Lippincott Co., 1960), p. 57.

[51] Floyd G. McCormick, op. cit., p. 10.

[52] Case, Johnson, and Buddemeier, op. cit., p. 58.

Appraisal of the developed instructional units was comprehensive in the attempt to measure their effectiveness. The primary emphasis in evaluation was accomplished through the efforts of students and pilot school teachers. A post-test administered to all students in both pilot and control schools established a measure of level of understanding of the profit-maximizing principles which was used for comparing the three techniques of farm management instruction. Student test scores were complemented by teacher appraisal of the units which was achieved by (1) the writer visiting each pilot school to (a) observe the use of and student response to the units and (b) obtain teacher impressions of the instructional units, (2) the use of a unit evaluative survey instrument, (3) an evaluation meeting with all pilot teachers, and (4) by weekly reports from teachers on "Daily Schedule of Activities" sheets.

Definition of Terms

1. Profit-maximizing principle: A generalized statement, assumed to be true, which provides an accepted guideline to sound decision-making which affects the profitability of the farm business. Economic principle, as used in this report, is synonymous with the above definition.[53]

2. Principle: A fundamental truth. A law of conduct which has general application, and which is a basis for action. It is a generalization based upon facts and upon elements of "likeness" common in a number of situations.

3. Inductive teaching and learning: This process involves going from the concrete to the abstract. Instruction starts not with a statement of the principle but with observed or described situations which illustrate the principle and which should lead students eventually to discover and state it with the

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[53] A list of the seven profit-maximizing principles used in this study is found in Appendix A.

assistance of the teacher. Inductive thinking generally begins with observed effects and leads eventually to the cause or causes.

4. Pilot school: A school used in this study where the teacher of vocational agriculture used instructional units prepared for teaching profit-maximizing principles. Pilot-block were those schools who used the materials in an uninterrupted sequence of time. Pilot-integrated were those schools using the materials by integrating them with other subject matter, generally over a longer period of time.

5. Control school: A school used in this study in which no attempt was made to deviate from the traditional program of farm management instruction. These schools were used for comparison purposes only.

6. Traditional manner of teaching farm management: This is the technique generally used by Ohio teachers of agriculture in teaching farm management to students of vocational agriculture. Typically it is taught to juniors and/or seniors in a classroom situation using the lecture and discussion methods. Farm analysis, problems, record keeping, finance, and management of enterprises are usually covered using a wide range of instructional time. Text material often used by teachers includes (1) student project account books, (2) Doane's Farm Management Guide, (3) Profitable Farm Management by Hamilton and Bryant, and (4) miscellaneous bulletins and brochures.

7. Technique of instruction: This term refers to the method of instruction, i.e. pilot-block, pilot-integrated, or control.

8. Level of understanding: A concept developed to express the extent of knowledge of basic economic principles possessed by students within the sample as measured by a post-test.

9. Participating teacher and/or school: A pilot or control teacher and/or high school in the state of Ohio cooperating in the trial use of the developed instructional units of profit-maximizing principles or teaching farm management by the traditional technique.

10. Instructional units, units, developed units, or units of profit-maximizing principles: Terms used to describe teaching units which were the basis of this study. They consisted of seven sections or individual units, each dealing with a specific economic principle and bound in a manual entitled, "Instructional Units On Profit-Maximizing Principles."

CHAPTER II

PROCEDURES USED IN MEASURING THE RELATIVE EFFECTIVENESS OF INSTRUCTIONAL UNITS

The primary purpose of this study was to measure the relative effectiveness of the developed instructional units to enhance student understanding of profit-maximizing principles when used in classes of vocational agriculture. Three techniques of instruction were appraised as they were influenced by thirteen independent variables to accomplish this purpose. The basic dependent variable employed in appraising relative unit effectiveness was student understanding of profit-maximizing principles as measured by a post-test.

Twenty-two schools with a vocational agriculture enrollment of 262 juniors and/or seniors participated in the study. There was close cooperation between the investigator and the participating schools throughout the orientation, trial, and evaluation periods. Several meetings were held with the groups, visits made to the individual departments, and a continuous communication by telephone and correspondence.

Procedures Used in Selecting Pilot and Control Schools

In order to appraise the effectiveness of the developed instructional units for teaching the understanding of profit-maximizing principles, it was necessary to make a careful selection of participating schools. Under the advisement of the writer's committee, pilot and control schools were employed. Control schools to teach farm management in the traditional manner were suggested, for without them valid results and comparisons with the experimental technique would be vague. Pilot schools used the instructional units in the manner suggested by the writer.

In reviewing educational research, it seemed apparent that the method of using pilot and control schools was an appropriate means for appraising different techniques of instruction. Hamlin substantiates this concept by stating, "Case studies, particularly the use of 'pilot centers' seems to be especially adapted to the field."[54] Campbell and Stanley further suggest that the most widespread designs in educational research involve an experimental group and a control group.[55] In discussing the merits of using both pilot and control groups, Borg points out that without the control the experimenter must assume that change in the pilot group was brought about by the experimental treatment.[56] Thus, control schools served as a basis from which level of understanding of profit-maximizing principles could be assessed. Borg continues to explain the values of the control group and its relation to the pilot or experimental group. He states:

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[54] H. M. Hamlin. Encyclopedia of Educational Research (New York: The Macmillan Company, 1960), p. 42.

[55] N. L. Gage (ed.), Handbook of Research on Teaching, American Educational Research Association (Chicago: Rand McNally and Company, 1963), p. 217.

[56] Walter R. Borg. Educational Research (New York: David McKay Company, 1963), p. 293.

> The essential difference between the single-group design and the control-group design is that the latter employs at least two groups of subjects, one of which is called the experimental and is included primarily to make it possible to measure the effects of external factors upon the post-test of the dependent variable; the treatment of the experimental and control groups is generally kept as close to identical as possible with the exception that the experimental group is exposed to the experimental treatment.[57]

Similarities among groups employed in this study was accomplished by use of random assignment of participating schools.

The task of selecting participating pilot and control schools was undertaken just before the close of the 1965-66 school year. On June 3, 1966 an inquiry of interest letter under the endorsement of Dr. Ralph E. Bender, Chairman, Department of Agricultural Education, The Ohio State University, and Warren G. Weiler, Head State Supervisor of Ohio Vocational Agriculture, was printed on Department stationery and mailed to 256 Ohio schools offering vocational agriculture.[58] This letter was sent to all departments with the exception of those with specialized horticulture programs, those who were known to be employing a non-experienced teacher for the following school year, and those schools from which the technical assistants who did the original design work of the instructional units came. It was believed by this researcher that the horticultural programs did not represent a typical vocational agriculture program nor would they benefit much at this time from the use of the instructional units. Schools having non-experienced teachers were deleted from inclusion for the advisory committee felt that these teachers would not be able to devote the time and effort to meetings, correspondence, and extra preparation that might be involved in an experimental endeavor. Obviously the technical assistants were already too familiar with the study to give it an unbiased trial.

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[57] *Ibid*., p. 295.

[58] A copy of this letter may be found in Appendix D.

Of the 256 letters of inquiry of interest, 112 teachers of vocational agriculture replied. From this number 12 teachers indicated no interest while 14 teachers failed to complete the reply card satisfactorily. Forty-six of the remaining eighty-six replies were concentrated in the west-central and north-central areas of Ohio. It was thus decided under advisement of the committee to choose from this concentrated group in order to conserve time and travel, and for the convenience of participating teachers. It was agreed by the advisory committee that 25 experimental schools should be chosen in order to assure a final sample size of at least 15 schools as originally called for in the study design. Therefore, 25 schools were randomly selected from the 46. Following this step, each of the 25 schools were randomly assigned to one of the three groups. These groups were to become the basic sample for the study and were labeled control, pilot-block, and pilot-integrated. After sample selection, three schools dropped out due to teacher change or sickness, leaving a balance of 22 with 6, 7, and 9 respectively for each group. These numbers appeared to this writer and his advisers to present an adequate range and balance within the schools and among the pilot and control groups.

Selected characteristics of participating schools within each group may be seen as listed in Tables.1, 3, and 3.

TABLE 1

SELECTED CHARACTERISTICS OF CONTROL SCHOOLS

School Number	Total School Enrollment	Total Vocational Agriculture Enrollment	Number of Students In Study	Number of Teachers
1	529	45	5	2
2	479	30	17	1
3	360	52	12	1
4	705	78	20	2
5	690[a]	39	7	1
6	733[b]	51	16	1
Total	3496	295	77	8
Mean	582.67	49.17	12.83	1.33

[a] Includes grades 7 through 12.

[b] Includes grades 10 through 12.

TABLE 2

SELECTED CHARACTERISTICS OF PILOT-BLOCK SCHOOLS

School Number	Total School Enrollment	Total Vocational Agriculture Enrollment	Number of Students In Study	Number of Teachers
7	603[a]	60	12	2
8	261[b]	34	7	1
9	464	49	19	1
10	369	37	11	1
11	305	42	11	1
12	929	83	13	2
13	345	61	4	2
Total	3276	366	77	10
Mean	468.00	52.29	11.00	1.43

[a] Includes grades 10 through 12.

[b] Includes grades 7 through 12.

In comparing the mean characteristics of the three groups it becomes apparent that the control schools are larger in size by a margin of more than 100 students. The pilot-integrated schools are the smallest with a mean of 426.11 which includes 3 schools with grades 7 through 12. Vocational agriculture enrollment was relatively constant with a range from 49.11 students for pilot-integrated schools to a high of 52.29 individuals for pilot-block schools. Average number of students in the study per school was also relatively even with a low of 11.00 for pilot-block to a high of 12.83 for control schools.

TABLE 3

SELECTED CHARACTERISTICS OF PILOT-INTEGRATED SCHOOLS

School Number	Total School Enrollment	Total Vocational Agriculture Enrollment	Number of Students In Study	Number of Teachers
14	473[a]	47	14	1
15	488	47	14	1
16	356	56	9	2
17	403	55	8	1
18	389	36	10	1
19	416[a]	40	15	1
20	379	50	11	1
21	577[a]	62	7	2
22	354	49	20	1
Total	3835	442	108	11
Mean	426.11	49.11	12.00	1.22

[a] Includes grades 7 through 12.

Figure 1 shows the geographical location of the participating schools.[59] Random selection of these institutions both in

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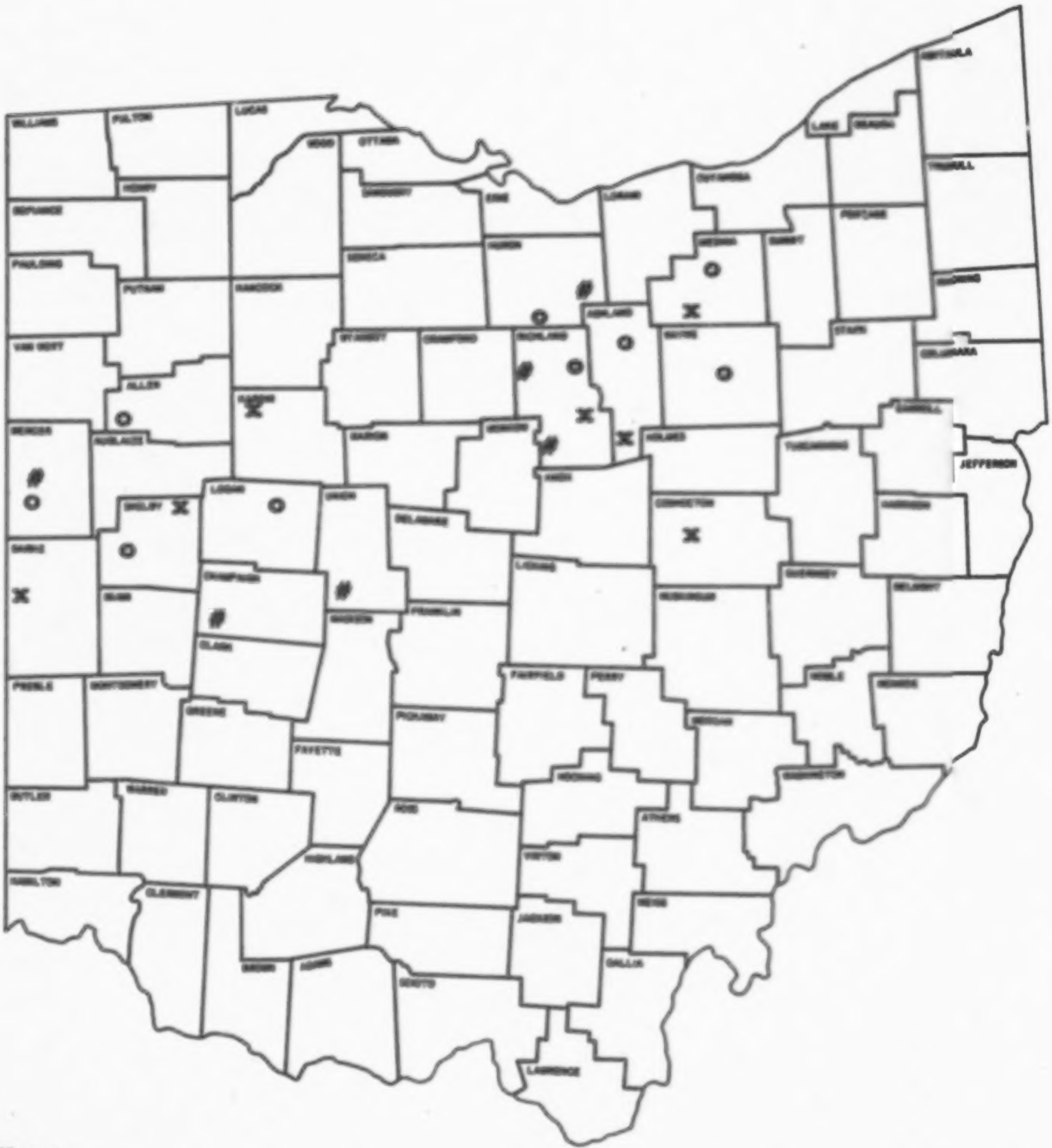
[59] A list of participating schools by group and number may be found in Appendix C of this study.

FIGURE I.

PARTICIPATING SCHOOLS



Key:
# control
x pilot-block
o pilot-integrated

total and in assignment to specific groups was believed by the investigating team to be a desirable method of sample selection. Random selection appeared to adequately obtain schools which well represented a cross-section of students, teachers, and departments for this section of the state of Ohio. Rummel suggests that random sampling "is a procedure by which the elements are drawn in such a way that there is no reason to believe that bias will result."[60] Random sampling also allows the use of more powerful statistical treatment of the obtained data. In random sampling each and every school within the population has an equal chance of being chosen for a participating department and assignment to a specific group. Siegel suggests that randomization is a useful and powerful technique. It aids in arriving at an unbiased sample as well as determining significance of the differences among groups. With randomization one can determine the probability associated with observations and can do so without assuming normal distributions or homogeneity of variance of the population.[61]

Two techniques of pilot school instruction used in this study were previously mentioned. These techniques have been labeled pilot-block and pilot-integrated. Pilot-block were those experimental schools which used the instructional units of profit-maximizing principles in an uninterrupted sequence of time. Pilot-integrated experimental schools used the same instructional units but by integrating them with other subject matter, generally over a longer period of time. The rationale for these two techniques was to gain a greater insight as to the change in understanding of the profit-maximizing principles through the use of different time sequences of teaching the same instructional units.

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[60] J. Francis Rummel. An Introduction to Research Procedures in Education (2nd Ed.; New York: Harper and Row, 1964), p. 74.

[61] Sidney Siegel. Nonparametric Statistics For The Behavioral Sciences (New York: McGraw-Hill Book Company, 1956), p. 152.

Procedures Used In Orientating Teachers With The Project

It was the aim of this researcher to keep the participating teachers of the profit-maximizing principles research project as well informed as possible regarding the purpose and status of the study. Every effort was extended to communicate with them, to involve both pilot and control teachers as much as possible while at the same time assisting them in carrying out their responsibilities with the project. The design of the study was intentionally simplified to refrain from overloading the participating teachers with unnecessary duties and loss of classroom instructional time.

By mid July, 1966, selection of participating schools had been made. Thus, on July 18, letters were sent to all schools that had previously responded to the June 3, 1966 inquiry of interest letter. All but the 25 selected schools representing the sample were sent word that the study committee was unable to include their department within the evaluation team. Sample schools were informed of their appointment as pilot or control centers. Copies of these letters are located in Appendix D of this study.

The selected pilot and control schools were given further instructions through the July letter. They were asked to obtain specific reference materials and informed of a seminar session to further acquaint them with the project. This seminar meeting was held on August 29, 1966, at The Ohio State University with the writer in charge. Ralph E. Bender, Chairman, Department of Agricultural Education and Warren G. Weiler, Head State Supervisor of Ohio Vocational Agriculture assisted by speaking to the teachers of the importance and significance of the project to Ohio vocational agriculture. Dr. Bender concentrated on the values of improved techniques of instruction and need for the movement toward a principles approach of instruction in vocational agriculture. Mr. Weiler emphasized the need for improvement in farm management instruction and stated that he believed the study to be a major contribution to this vital phase of the vocational agriculture curriculum. Floyd G. McCormick, of the Department of Agricultural Education, The Ohio State University, was instrumental in assisting the teachers to perceive the need for change and the directions to follow to accomplish the desired goals to improved farm management instruction. Dr. McCormick outlined the rationale and design for the new approach to teaching the understanding of profit-maximizing principles. The writer coordinated the efforts of those in attendance at the initial orientation meeting. He worked with teacher educators, state supervisors, and teachers in formulating plans, time schedules, expectations from participating schools, and attainment of needed data. Ideas regarding teaching techniques, instructional periods, class observational visits and progress evaluation were discussed with the meeting attendants.

The initial orientation meeting of August was followed by two separate local area seminar meetings with pilot school teachers only. On September 26 and October 6, 1966, Floyd G. McCormick and the writer met with the experimental school teachers at Lucas High School and Jackson Center High School respectively. The purpose of these meetings was to specifically acquaint the participating pilot school teachers with the developed instructional units of profit-maximizing principles. The design of the instructional units, the use of the inductive process and the discovery approach to the principles technique was explained and demonstrated to the participating teachers. Techniques of instruction, methods of application and relationship with farm management and other subject matter were discussed. Ideas were presented as to suggested demonstrations, teaching aids, and references to be used in teaching the understanding of profit-maximizing principles.

Individual conferences were conducted throughout the entire trial period with teachers and other persons related to the study. The writer kept in close contact with all pilot and control teachers and state supervisors of vocational agriculture. He informed them of the purpose and status of the project and maintained a continuous line of communication with these individuals to disclose any new developments or directions and to obtain suggestions and feed-back from them.

Field Supervision of Participating Schools

A carefully planned and structured program was organized to coordinate the efforts of pilot and control school teachers. All of the participating teachers were asked to set aside a period of time between October 17, 1966, and March 17, 1967, to teach farm management in the traditional manner or to use the developed instructional units on profit-maximizing principles. Control school teachers were asked to make no change in their farm management instructional program. Pilot school teachers were asked to allot approximately six weeks for teaching the understanding of profit-maximizing principles through the inductive process of the discovery method. Pilot schools designated as integrated were requested to combine the developed units with other subject matter at some time between the above dates and to use the same teaching process.

Shortly after farm management instruction commenced at a given school within the study, the writer planned a visit with the local vocational agriculture teacher. The purpose of this visit was to assist the teacher in carrying out the use of the developed instructional units or to become acquainted with farm management instruction in the case of control schools. The writer furthermore observed the use of instructional techniques and student response to teaching. Teachers were notified in writing at least one week before the visit took place.[62] A diagram showing visitation dates is included in Appendix F of this study. One observational visit was made to each school within the study. These visits occurred between November 8, 1966, and February 16, 1967.

All participating teachers were asked to keep a daily schedule of activities of their class involved in the study, throughout the period of farm management instruction. They were to keep a record of subject matter covered, class activities, and to note any problems, questions, or suggestions that might be helpful for the improvement of the project. Reporting forms labeled, "Daily Schedule of Activities," were to be sent to the writer each week during the farm management instruction period. A copy of this reporting form is attached to Appendix B of this study. The writer found the use of weekly reporting by teachers to be very helpful in being cognizant of teacher progress in using the instructional units and specific subject matter covered in farm management instruction. Teacher comments were an aid in evaluating techniques of instruction as well as the instructional materials.

In January a letter was sent to all principals of participating schools. The purpose of this letter was to further inform school administrators of the progress being made by the profit-maximizing principles project, the involvement of the local vocational agriculture department, and to thank them for their support. It was believed by this writer that such a feat would strengthen cooperative relations among the Department of Agricultural Education, the local school, and personnel involved in the study. A sample copy of this letter is included in Appendix D of this study.

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[62] A typical copy of this letter is found in Appendix D.

Procedures Used In Evaluating Student Understanding

The purpose of this study was to measure the relative effectiveness of the developed instructional units to enhance student understanding of profit-maximizing principles when used in classes of vocational agriculture. To accomplish this purpose, it was necessary to test students of the pilot and control schools to determine their level of understanding after completion of traditional farm management or the experimental technique of instruction. It was first believed that pre-testing was necessary in order to establish a common base for the three groups; i.e., control, pilot-block, and pilot-integrated. However, the goal was to determine the level of understanding and not the growth of understanding of profit-maximizing principles. Due to this fact, the conditioning affect, and the use of random assignment of individual schools to specific groups, it was decided by the writer and his advisory committee that pre-testing was not necessary.

Campbell and Stanley support this procedure in their Research Design number 6 by stating:

> While the pretest is a concept deeply embedded in the thinking of research workers in education and psychology, it is not actually essential to true experimental designs. . . . The most adequate all-purpose assurance of lack of initial biases between groups is randomization. Within the limits of confidence stated by the tests of significance, randomization can suffice without the pretest.[63]

As previously stated in this chapter, the study design was to minimize unnecessary teacher duties and loss of classroom instructional time. Because of this, the support of the advisory committee, and the foregoing statements, all pre-testing was deleted from the study.

Selection of Evaluative Test

Farm management instruction focuses upon the decision-making process whether it be by the traditional technique or by the profit-maximizing principle approach. Decision making involves the collection of facts on which to evaluate alternative courses of action and is the precursor to making decisions toward optimizing profits of the agricultural business. Deliberations not only involve monetary and physical values, but also economic relationships commonly known as principles. Thus, it is logical to assume that an understanding of basic profit-maximizing principles is a prerequisite to sound decision making. The ultimate objective of any new instructional technique of the principles approach is not the rote memorization of economic principles per se, but the understanding and use of them. Application of principles and their relationship among enterprises of the entire agricultural business must be understood. Heady and Jenson suggest that, "there is not a separate principle or rule for each single part of the business--each principle applies to all parts."[64] Thus, understanding and not memorization is the goal of instruction.

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[63] N. L. Gage (ed.), op. cit., p. 195.

To determine the use and understanding of economic principles, this researcher accepted, under the advisement of his committee, the evaluative instrument developed by McCormick.[65] The exam is entitled "Multiple Choice Questions on Farming" and consists of 45 forced choice questions. A copy of it is enclosed in Appendix B of this study. McCormick's instrument was well prepared and tested, and was readily available through the Department of Agricultural Education of The Ohio State University. The instrument was tested by McCormick in 1963 on discriminate groups of efficient and non-efficient farm operators from 158 farmers borrowing from the Farmers Home Administration in Ohio, and selected on the basis of their management analysis data. In 1966 the same instrument was used again by Rolloff in formulating a basic design to assess the relative degree of effectiveness of instruction in farm management.[66] In his study, 27 farm operators participating in farm business planning and analysis programs from five Ohio high schools, were tested. Through the investigation, development and use of this exam, its validity and reliability have been evaluated for young adult farm operators. This study of appraising the effectiveness of instructional units employs the exam for the first time with high school juniors and seniors enrolled in vocational agriculture. The advisory committee of this study was of the opinion that this age and experience difference would not detract from the validity of the instrument.

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[64] Earl O. Heady and Harald R. Jensen. Farm Management Economics (Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1964), p. 54.

[65] McCormick, op. cit.

Administering the Test

Post-tests for evaluating student understanding of profit-maximizing principles were administered to all students involved in the project at some time between November and March. Originally, the study design called for testing all participating students in February and March. However, under the recommendations of the advisory committee, testing was performed within two weeks after the completion of farm management instruction in both pilot and control schools. It was believed by the committee that this method would give equal opportunities to all students regardless of date of instruction. Thus, some schools had completed the post-test before others had begun instruction. A matrix showing testing dates is located in Appendix F.

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[66] Rolloff, op. cit.

All exams were administered by the writer. This procedure allowed for consistency of routine among schools. It also offered a continuous knowledge of exam locations, thus reducing the risk of contamination by lost tests. By traveling to all 22 schools to administer the test the opportunity was provided to visit and observe once again within the department. This allowed further discussion of the merits of the pilot and control techniques to farm management instruction with local teachers.

A tentative post-testing date was mutually agreed upon by the local teacher and the writer at the time of the original observation visit. Later this date was confirmed by letter. The letter included the date, time, number and type of questions, and the approximate time required for the student to complete the exam. A typical copy of this letter is found in Appendix D of the study.

No time was wasted in proceding with the introduction of the instrument once the hour of the exam had arrived at a given school. Students were given directions followed by any possible questions they might have. Generally the examinees had no questions and appeared to understand the directions and design of the test. No time limit was placed on the students. Some students completed the exam in 30 minutes while others used as much as 60 minutes. Most students averaged one minute per question with a total of 45 minutes to complete the entire exam. This range was attributed primarily to individual differences in reading speed and comprehension. It was believed by the writer that individual students would become tired and restless and thus their responsiveness and reading ability might decrease. In order to compensate for this fatigue factor, pages of the exam were rotated when originally assembled. This procedure eliminated the chance for discrimination between any one page of questions. Because of ten pages containing an average of 4.5 questions per page, it was possible to assemble ten combinations of the instrument.

A total of 262 students took the exam. This represented 92 per cent of those students who were originally included in the sample. The 8 per cent mortality was due to absenteeism on the post-test date. Loss of students was approximately the same for all three groups in the study.

Exams were returned to The Ohio State University by this researcher where he immediately scored them. Grades were recorded and sent to the participating teachers within three days. Scores were determined by the percentage of questions answered correctly. Each of the 45 questions on the post-test dealt with a specific instructional unit or profit-maximizing principle.[67] For this reason correct questions were grouped accordingly to determine the relationship, if any, to student understanding of a given principle.

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[67] The assignment of given questions to specific units or principles is found in Appendix B.

Procurement of Related Data

Related data on schools, teachers, and students were deemed necessary for further insights to the effectiveness of the developed instructional units. It was from these data that interrelationships among student understanding of profit-maximizing principles, as measured by the post-test, and the independent variables were studied. Participating teachers were asked to supply information in reference to all the independent variables as listed on the following page. They obtained this information from the vocational agriculture department and school records.

Of all the information asked for, I.Q. scores were the most difficult to obtain. This was due to a variety of I.Q. tests used by the participating schools and the movement of students from one school to another. In a few cases I.Q. scores were not available; therefore, the guidance department within the school was asked to administer an exam to the students involved in the study.

Much of the related data were forwarded to this researcher by means of a "Tabulation Sheet" furnished to the participating teachers. A copy of this instrument is included in Appendix B.

Selection of Independent Variables

The purpose of the developed units was to enhance student understanding of profit-maximizing principles when used in classes of vocational agriculture. Since it was believed by this researcher and his committee that several factors might influence this understanding, it was necessary to determine what they were in order to effectively evaluate the impact of the instructional units.

Many factors or independent variables were suggested by the writer's advisers to be included in the study. After much deliberation, study, and discussion, the following items appeared to have the greatest influence upon the results of the new technique of teaching farm management.

1. Student year in vocational agriculture.
2. Student year in high school.
3. Student years of farm experience.
4. Student I.Q.
5. Economics courses taken by students in high school.
6. Number of teachers in the vocational agriculture department.
7. College quarter hours of economics instruction received by the teacher.
8. Teacher having received Farm Business Planning and Analysis instruction.
9. Teacher having coordinated a Farm Business Planning and Analysis program.
10. Teacher's years of teaching experience.
11. Teacher's attainment of an advanced degree.
12. Hours of instructional time used.

It seemed logical to believe that the older and more experienced a student was the greater his understanding of profit-maximizing principles would be. His high school experiences should have influence upon his study habits, subject matter understanding, depth and breadth of learnings and general appreciation and understanding of agricultural business. Involvement in farming and classwork in vocational agriculture should tend to strengthen his knowledge of economic concepts and managerial ability. For these reasons the years of enrollment in high school and vocational agriculture were carefully studied as was student years of farm experience and possible attainment of high school economics courses.

Student I.Q. was believed to be a major influencing factor in the evaluation of the instructional units. Like other subject matter, it was assumed that the student's I.Q. would alter his achievement in the study of farm management. Therefore, it was necessary to determine how much influence this independent variable would have in masking the relative effectiveness of the profit-maximizing principles instructional units. To facilitate the study and to hold teacher and student interruptions to a minimum, the decision was made by the researcher and his advisers to use whatever I.Q. test was available at the participating schools. Because of this it became necessary to equate several different I.Q. tests. After discussing the equating problem with Dr. Robert W. Ullman, Director, Orientation and Testing Center, The Ohio State University, and with Dr. David W. Winefordner, Assistant

Director, Division of Guidance and Testing, State of Ohio Department of Education, and reviewing technical manuals for each of the individual I.Q. tests, it was concluded that no precise conversion technique existed. Ullman and Winefordner recommended using the scores provided by the local schools without altering them since they were all based on an approximate mean of 100 and a standard deviation of 15. Since there was a mixture of tests used within each of the three major groups of schools involved in the study, little if any adverse affects would distort the ratings of one group against another.

Teachers and their experiences are considered by most educators as major influences upon student achievement. Therefore, teachers and their experiences and qualifications were carefully evaluated as to their influence upon student achievement in farm management and understanding of profit-maximizing principles. The trend to larger vocational agriculture departments with two or more teachers is believed to be advantageous to the student. For this reason post-test scores of students enrolled in single versus double teacher departments were studied to determine if this factor had any influence upon understanding of economic principles. Many educators in agriculture believe the concentrated study with established farmers of their individual farm businesses is of major concern to local vocational agriculture departments. They also believe that if the local instructor is versed in this farm management training method, he is able to relate more pertinent farm management instruction to his high school students. To further investigate this belief, comparisons were made between post-test scores of students whose teachers had experienced Farm Business Planning and Analysis instruction and/or coordination of local programs. It seems logical that the more years of teaching experience and college economic instruction, and the attainment of a Masters degree would aid the teacher in more effectively instructing his students. To appraise this logic these independent variables were compared with student achievement on the post-test. It is conceivable that the greater amount of instructional time used in teaching farm business management the greater the students' understanding would be of profit-maximizing principles. In testing this assumption a careful study was conducted to correlate student post-test scores with hours of instructional time used during the trial period.

Later, one more independent variable was annexed to those already discussed. The addition was that of comparing the individual student's post-test score with his grades earned on exams administered by his teacher during the trial period. It was believed by this writer that there should be a strong correlation between the two evaluative techniques, subsequently reinforcing the validity of the post-test. Since this independent variable was not included in the original design of the study, the data is incomplete for all participating schools. For this reason only limited application was made of this annexed item.

Procedures Used In Securing Teacher Evaluation of the Instruction Units

Any innovation in instruction should be evaluated by those who experience the use of the neoteric technique. For this reason it was imperative to obtain teacher impressions of the developed instructional units on profit-maximizing principles.

Pilot teacher evaluation of the units was secured by four methods. First, teachers were asked by the writer during observational and post-testing visits to comment on their impressions of and experiences with the developed units. Secondly, a two page teacher evaluative instrument was developed by the writer under the advisement of his committee and mailed to all pilot schools. A copy of this instrument and its cover letter may be found in Appendix G. The third method of teacher appraisal was by means of a meeting with all pilot teachers held at The Ohio State University on February 18, 1967, which immediately followed the above survey. The purpose of the evaluation meeting was to review the strengths and weaknesses of the individual instructional units and to make suggestions for their improvement. The meeting announcement also served as the cover letter to the instrument mentioned above. The fourth method of securing teacher appraisal of the units was through weekly reports mailed to the writer. These "Weekly Schedule of Activities" sheets also served the function of keeping the writer informed of teacher progress and current activities. A summary of the teacher evaluation is presented in Chapter IV.

CHAPTER III

STATISTICAL ANALYSIS OF DATA OBTAINED IN MEASURING THE RELATIVE EFFECTIVENESS OF INSTRUCTIONAL UNITS

The statistical analysis of the data obtained in the pursuit of measuring the relative effectiveness of instructional units of profit-maximizing principles is presented in this chapter. Treatment of data includes an analysis of the relationship among three techniques of farm management instruction and post-test questions associated with the seven instructional units. Statistical analysis is also presented depicting the relationship of thirteen independent variables as influencing student understanding of the profit-maximizing principles first in total and secondly as individual units.

Procedures Used in Data Analysis

Basic data analysis was performed through the use of IBM cards and electronic computer processing. Information concerning students, teachers, and participating schools, was placed on tabulation sheets as it was gathered. Later, it was transferred to coding sheets and a master code accompanied by completed post-tests for each student within the study and taken to the Statistical Laboratory of The Ohio State University. Punching of the coded data and post-test responses into IBM cards was then performed by lab personnel. The punched cards were later processed through the IBM 7094 computer located at Robinson Laboratory, The Ohio State University. A copy of the coding sheets and the coding master used are located in Appendix H of this study.

Selection of Statistical Models

For assistance in selecting the appropriate statistical models for this study, the writer consulted two learned individuals. Dr. Ransom D. Whitney, Director of the Statistical Laboratory, Department of Mathematics, and James B. Hamilton of the Ohio Research Coordinating Unit for Vocational Education, both of The Ohio State University, offered continuous guidance in this research.

The first major objective of the study was to determine which of three techniques of instruction resulted in the greatest level of student understanding of profit-maximizing principles. To achieve this objective a post-test was administered to all participating students in both control and pilot schools. The results received from this instrument were compiled and subjected to the parametric technique of analysis of variance by the F test to determine the significance of difference among and between each of the three groups using the various techniques of farm management instruction. The Duncans multiple range statistic of significance of difference was then applied to the data to determine which of the groups were homogeneous subsets.

A second objective of the study was to determine the relationship between the dependent variable of student understanding of profit-maximizing principles and the following list of thirteen independent variables:

1. Student year in vocational agriculture.
2. Student year in high school.
3. Student years of farm experience.
4. Student I.Q.
5. Economic courses taken by student in high school.
6. Number of teachers in vocational agriculture department.
7. College quarter hours of economics instruction received by the teacher.
8. Teacher having received Farm Business Planning and Analysis instruction.
9. Teacher having coordinated a Farm Business Planning and Analysis program.
10. Teacher's years of teaching experience.
11. Teacher's attainment of an advanced degree.
12. Hours of instructional time used.
13. Local grades (achieved by student).

All independent variables were first analyzed by the use of the Pearsonian product-moment correlation coefficient r. This statistical technique was recommended by Whitney[68] to give a general overall indication of the magnitude and direction of the relationships between the dependent and the independent variables.

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[68] Ransom D. Whitney, Director, Statistical Laboratory, Department of Mathematics, The Ohio State University.

Following the employment of the Pearsonian r, the independent variables were grouped into categories and examined in greater detail. This procedure was recommended since the variables differed in level of measurement. Three different statistical techniques offered the opportunity to more precisely determine the relationship of each independent variable upon the dependent variable of understanding of profit-maximizing principles when the three techniques of instruction were used. Those independent variables offering only a positive or negative response were analyzed by using the t test to determine the significance of the differences between groups. In the case of interval data associated with the independent variables, one-way analysis of variance was employed. The third group of independent variables was of an ordinal nature which allowed continued use of the Pearsonian r.

A third objective of the study was to determine the relationship of the independent variables upon student understanding of each of the profit-maximizing principles pertaining to the seven instructional units. The purpose of this objective was to further analyze the units as to their individual merits. To accomplish this task, the same basic procedures were used as employed in the previous objective when independent variables were compared with total post-test scores. In accomplishing objective three, a comparison was made between scores received by students regarding the seven individual instructional units and the thirteen independent variables when taught by three different techniques of instruction.

Comparison of Mean Post-Test Scores Among Participating Schools

The first objective of this study was to determine which of the three techniques of farm management instruction resulted in the greatest level of student understanding of profit-maximizing principles. In achieving this objective, mean post-test scores were compiled for each of the three groups; i.e., control, pilot-block, and pilot-integrated. These data were then subjected to the F test to determine the variance of the three mean scores.

Comparisons With All Seven Units Combined

Table 4 shows the comparison of mean post-test scores for each group of students receiving instruction by the three techniques of farm management instruction.

Mean scores ranged from a low of 54.0 per cent correct responses by control schools to a high of 61.3 per cent for pilot-block schools. Students enrolled at the pilot-integrated schools achieved a score of 58.4 per cent which was similar to the 58.0 per cent obtained by all schools combined. It is also noted that standard deviation of scores for both pilot groups was 16.9 whereas the control group deviated about the mean by a 14.8 value. Although scores earned by all groups appeared similar, there was a significant difference among them. In using the F test to determine this difference, a value of 4.01 was derived. This value is interpreted as being significant at the 5 per cent level since the critical value needed at this point of confidence was 2.996. The 5 per cent level is defined as meaning that in only 5 times in 100 would this difference occur by chance alone.[69]

TABLE 4

COMPARISON OF MEAN POST-TEST SCORES BY GROUPS OF STUDENTS

No.	Group	N	Post-Test Score	Standard Deviation
1	Control	77	54.0	14.8
2	Pilot-Block	77	61.3	16.9
3	Pilot-Integrated	108	58.4	16.9
	All Groups	262	58.0	16.5

Critical value needed at .05 level of significance = 2.996.
F value = 4.01

Multiple Range Test:

	Homogeneous Subsets	Differences
Groups	(1-3), (2-3)	(1-2)

The Duncans multiple range statistical technique was applied following the F test to find the location of the significant difference among the three mean post-test scores. The results of this investigation may be seen on the lower section of Table 4. This section shows that groups 1 and 3 (control and pilot-integrated) as well as groups 2 and 3 (pilot-block and pilot-integrated) are homogeneous. It further reveals that the significant difference appears between groups 1 and 2. This means that while students in group 3 achieved a higher post-test score than those in the control groups, they continued to remain in a homogeneous subset. It also demonstrates that the major difference was between the control and the pilot-block groups, and that this difference was significant.

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[69] A complete listing of mean scores for all individual participating schools is located in Appendix F.

Comparisons With Individual Units

The preceding procedures used with total mean scores for respective participating groups were again performed with each of the seven instructional units. Individual investigation of each unit was undertaken to further appraise the merits of the developed units concerning the profit-maximizing principles. The results of this investigation proved the developed units to be worthy of enhancing student understanding of profit-maximizing principles beyond the levels reached by the traditional technique of teaching farm management. Tables 5 through 11 show the comparisons among the control and the two pilot groups for each of the seven units. With the exception of two units, the pilot-block experimental group achieved the highest score on the post-test. This group was followed in turn with the pilot-integrated group, trailed by the control schools which occupied third level achievement. Standard deviations on mean correct responses remained relatively constant for all units. Homogeneous subsets obtained through the use of the Duncans multiple range statistic complement each unit by being listed at the base of individual tables.

Table 5 reveals the comparison of unit one mean post-test scores by groups of students.

TABLE 5

COMPARISON OF UNIT ONE (DIMINISHING PHYSICAL RETURNS) MEAN POST-TEST SCORES BY GROUPS OF STUDENTS

No.	Group	N	Post-Test Score	Standard Deviation
1	Control	77	58.4	20.7
2	Pilot-Block	77	68.4	25.7
3	Pilot-Integrated	108	65.1	27.1
	All Groups	262	64.1	25.2

Critical value needed at .05 level of significance = 2.996.
F value = 3.20

Multiple Range Test:

	Homogeneous Subsets	Differences
Groups	(1-3), (2-3)	(1-2)

The difference among the means was significant at the .05 level with an F value of 3.20. The major difference among means was located between the control and pilot-block groups with a spread of 10 percentage points.

Table 6 shows mean post-test score comparisons for unit two.

TABLE 6

COMPARISON OF UNIT TWO (DIMINISHING ECONOMIC RETURNS)
MEAN POST-TEST SCORES BY GROUPS OF STUDENTS

No.	Group	N	Post-Test Score	Standard Deviation
1	Control	77	50.0	24.2
2	Pilot-Block	77	62.3	25.7
3	Pilot-Integrated	108	57.1	21.3
	All Groups	262	56.6	23.9

Critical value needed at .01 level of significance = 4.605.
F value = 5.33

Multiple Range Test:

	Homogeneous Subsets	Differences
Groups	(1-3), (2-3)	(1-2)

This unit displayed the greatest significance of difference among the mean scores of any of the seven instructional units. The F value was 5.33 which was in excess of the value needed for the difference to be statistically significant at the .01 level of confidence. Pilot-block schools achieved a high score of 62.3 per cent correct responses compared with 50.0 per cent for control schools. This is a difference of 12.3 points.

Unit three comparisons are depicted in Table 7.

TABLE 7

COMPARISON OF UNIT THREE (FIXED-VARIABLE COSTS) MEAN POST-TEST SCORES BY GROUPS OF STUDENTS

No.	Group	N	Post-Test Score	Standard Deviation
1	Control	77	54.0	19.7
2	Pilot-Block	77	61.6	19.6
3	Pilot-Integrated	108	56.6	23.4
	All Groups	262	57.3	21.4

Critical value needed at .05 level of significance = 2.996.
F value = 2.56

Multiple Range Test:

	Homogeneous Subsets	Differences
Groups	(1-2-3)	None

This table shows a narrow margin between control schools and pilot-integrated schools with scores of 54.0 and 56.6 respectively. Pilot-block schools again attained the high score with a reading of 61.6. Standard deviations of scores were among the lowest in unit three of all the instructional units with an all school average of 21.4. It was exceeded only by unit five. The

F value closely approached the .05 level of confidence.

A substantial difference among mean test scores was obtained in unit four as shown in Table 8.

TABLE 8

COMPARISON OF UNIT FOUR (SUBSTITUTION) MEAN POST-TEST SCORES BY GROUPS OF STUDENTS

No.	Group	N	Post-Test Score	Standard Deviation
1	Control	77	52.7	27.2
2	Pilot-Block	77	64.7	24.5
3	Pilot-Integrated	108	60.7	23.5
	All Groups	262	59.5	25.3

Critical value needed at .01 level of significance = 4.605.
F value = 4.72

Multiple Range Test:

	Homogeneous Subsets	Differences
Groups	(1-3), (2-3)	(1-2)

An F value of 4.72 was significant beyond the .01 level. The 52.7 mean score achieved by control schools compared with 64.7 for pilot-block schools exhibited one of the greatest differences between means of any unit. It was exceeded only by unit two. Standard deviations of scores in unit four were the highest of all the instructional units with a 25.3 average for all groups. Homogeneous subsets of this unit resembled other units in that the control and pilot-block groups demonstrated the greatest difference between means.

Results obtained in unit five deviated from the previous patterns as displayed in Table 9.

TABLE 9

COMPARISON OF UNIT FIVE (OPPORTUNITY COSTS) MEAN POST-TEST SCORES BY GROUPS OF STUDENTS

No.	Group	N	Post-Test Score	Standard Deviation
1	Control	77	43.0	18.5
2	Pilot-Block	77	51.6	21.5
3	Pilot-Integrated	108	52.0	21.1
	All Groups	262	49.2	20.8

Critical value needed at .01 level of significance = 4.605.
F value = 5.00

Multiple Range Test:

	Homogeneous Subsets	Differences
Groups	(1-2), (2-3)	(1-3)

While the control schools remained with the lowest mean score with a 43.0 reading, the pilot-integrated group obtained the highest score with a 52.0 per cent achievement. Mean scores and standard deviations of unit five were the lowest of all instructional units with an all group mean of 49.2 and 20.8 respectively. Nevertheless, the difference was significant at the .01 level and obtained the second highest F value of all units. Homogeneous subsets were groups 1 and 2 and groups 2 and 3. Major difference among means existed between groups 1 and 3.

Table 10 reveals unit six.

TABLE 10

COMPARISON OF UNIT SIX (COMBINATION OF ENTERPRISES) MEAN POST-TEST SCORES BY GROUPS OF STUDENTS

No.	Group	N	Post-Test Score	Standard Deviation
1	Control	77	53.3	22.3
2	Pilot-Block	77	57.2	23.5
3	Pilot-Integrated	108	55.7	25.4
	All Groups	262	55.4	23.9

Critical value needed at .05 level of significance = 2.996.
F value = .52

Multiple Range Test:

	Homogeneous Subsets	Differences
Groups	(1-2-3)	None

Mean scores for all three groups were very similar with an average of 55.4 for all schools. Consequently the F value of .52 is the lowest exhibited by any of the seven instructional units. Even with the similarity of scores, the same general relationship existed with control schools obtaining the lowest mean score followed by pilot-integrated and pilot-block. The Duncans multiple range test revealed all three groups to be within the same subset.

Unit seven is shown in Table 11.

TABLE 11

COMPARISON OF UNIT SEVEN (TIME RELATIONS) MEAN POST-TEST SCORES BY GROUPS OF STUDENTS

No.	Group	N	Post-Test Score	Standard Deviation
1	Control	77	68.4	20.5
2	Pilot-Block	77	64.7	20.9
3	Pilot-Integrated	108	63.3	24.9
	All Schools	262	65.2	22.6

Critical value needed at .05 level of significance = 2.996.
F value = 1.19

Multiple Range Test:

	Homogeneous Subsets	Differences
Groups	(1-2-3)	None

Again mean scores ranged closely about the mean. The all group mean of 65.2 is the highest achieved on any of the units. Different from all other units, in unit seven the control group obtained the highest mean score with a reading of 68.4. Pilot-block and pilot-integrated schools were close behind with scores of 64.7 and 63.3 respectively. The F value was the second lowest of all units as depicted by a 1.19 value. All three groups of schools were within the same homogeneous subset.

Summary of Objective One Accomplishment

Objective one of this study was to determine which of three techniques of farm management instruction resulted in the greatest level of student understanding of profit-maximizing principles. By comparing groups of students who received farm management instruction by one of the three different instructional techniques, the objective was accomplished.

Results of the total post-test measuring the understanding of seven profit-maximizing principles proved beyond the .05 level of confidence that the pilot-block group using the developed instructional units in a block of instructional time to be superior to either of the other two techniques. This group received a test score of 61.3 per cent. The pilot-integrated group was significantly above the control group with test scores of 58.4 and 54.0 per cent respectively. It is concluded that the instructional units did indeed enhance student understanding of profit-maximizing principles beyond the traditional technique of teaching farm management used by control schools. It is also concluded that the pilot-block technique was more effective in strengthening student achievement.

Test scores received by students concerning each of the profit-maximizing principles revealed a similar outcome as did the total test covering all seven units. The pilot-block group excelled the other two groups on five of the units. Control and pilot-integrated groups obtained the highest score on one unit each. The former achieved the lowest score whereas the latter obtained second rating on five units each. It is, therefore, concluded that since pilot-block schools achieved the highest level on most of the units followed by pilot-integrated and control schools, the instructional units were effective in enhancing student understanding of individual profit-maximizing principles.

The null hypothesis established in Chapter I which stated that there would be no significant difference among the pilot and control schools relative to level of understanding of profit-maximizing principles as measured by a post-test was, therefore, rejected.

Relationships Between Student Understanding of All Profit-Maximizing Principles Combined And The Independent Variables

The second objective of the study called for determining the relationship between the dependent variable of student understanding of profit-maximizing principles and thirteen independent variables. To accomplish this objective, the variables were first subjected to the Pearsonian product-moment correlation coefficient r to give an overall indication of their influence upon the total post-test score. With a total of 262 observations being used in the study, flexibility in the employment of statistical techniques was permitted. By using mean values attached to each observation, it was possible to use the Pearsonian r. A complete list of correlation coefficients for each of the independent variables by groups of students is located in Appendix F of this study.

To more closely analyze the independent variables, they were grouped into four subsets. Grouping was done because of differences in levels of measurement among the variables. Relatively small numbers and different levels of measurement suggested the use of divergent statistical techniques to more precisely determine significant influences upon the dependent variable. Each of the independent variables is discussed separately within its respective subset under the following headings:

1. Two-way response
2. Three-way response
3. Multiple response
4. Incomplete response.

Two-Way Response

Six independent variables of this study dealt with two-way or yes or no response. In each case there were only two possible answers. An appropriate statistical technique to determine significance difference between two groups is the t test. For this reason it was applied to the following list of independent variables to determine which alternative had the closest relationship to the total post-test score.

Independent Variables:

1. Student year in high school.
2. Economic courses taken by students in high school.
3. Number of teachers in vocational agriculture department.
4. Teachers having received Farm Business Planning and Analysis instruction.
5. Teachers having coordinated a Farm Business Planning and Analysis program.
6. Teacher's attainment of an advanced degree.

Student Year in High School was either junior or senior. All students participating in this study were within this classification, although their vocational agriculture class was one of three combinations. Participating classes consisted of all juniors, all seniors, or a combination of both. For the purposes of this study, the only differential was between the years students were currently enrolled in high school. Table 12 lists the percentages of students from each of the three major study groups who were juniors or seniors during the trial period. It can be observed that control schools had the greatest ratio of juniors enrolled with 74 per cent compared with pilot schools which had more seniors than juniors. The all school average was approximately equal with 49 per cent juniors and 51 per cent seniors.

The t test of significance indicated the influence of grade level upon the student test score. These values are depicted

TABLE 12

PER CENT OF STUDENTS ENROLLED IN THEIR JUNIOR OR SENIOR YEAR OF HIGH SCHOOL

Groups	N	Junior	Senior
Control	77	74	26
Pilot-Block	77	38	62
Pilot-Integrated	108	40	60
All Schools	262	49	51

TABLE 13

COMPARISON BETWEEN MEANS OF TOTAL POST-TEST SCORES FOR STUDENTS ENROLLED IN THEIR JUNIOR OR SENIOR YEAR OF HIGH SCHOOL

	Control	Pilot-Block	Pilot-Integrated	All Schools
Juniors				
N	57	29	43	129
Mean Score	54.2	64.4	60.7	60.9
Seniors				
N	20	48	65	133
Mean Score	53.3	56.2	55.1	54.8
Difference in Mean Scores	.9	8.2	5.6	6.1
t =	.561	-1.137	.521	- .568

in Table 13. This table shows that there was no statistical difference between mean post-test scores achieved by students within the two grade levels. An all school t value of a slight .568 was derived. This would indicate that it makes little difference as to understanding of profit-maximizing principles whether farm management is taught during the junior or senior year of high school.

Economic Courses Taken by Students in High School was a minor independent variable in this study. Only a very few students were currently or had previously enrolled in an economics course during high school. Table 14 shows the unbalanced relationship between the students who had enrolled in economics courses and those who had not.

TABLE 14

PERCENTAGE OF STUDENTS WHO HAD AND WHO HAD NOT ENROLLED IN AN ECONOMICS COURSE

Group	N	Enrolled	Not Enrolled
Control	77	.04	99.96
Pilot-Block	77	.04	99.96
Pilot-Integrated	108	17.60	82.40
All Schools	262	9.50	90.50

It can be noted that only .04 per cent had experienced an economics course in both the control and pilot-block groups. This was a total of 3 students for each group. Pilot-integrated schools had 19 students who received economics instruction during high school. In none of the groups was the number large enough to justify any conclusions.

Table 15 indicates that there was no statistical difference between the means of total post-test scores of those students who had experienced economics courses and those who had not.

TABLE 15

COMPARISON BETWEEN MEANS OF TOTAL POST-TEST SCORES FOR STUDENTS WHO HAD AND THOSE WHO HAD NOT ENROLLED IN AN ECONOMICS COURSE

	Control	Pilot-Block	Pilot-Integrated	All Schools
Had Economics Course				
N	3	3	19	25
Mean Score	39.3	71.1	56.4	56.0
No Economics Course				
N	74	74	89	237
Mean Score	54.7	63.8	58.9	58.2
Difference in Mean Scores	15.4	7.3	2.5	2.2
t =	- 1.964	.864	- .694	- .538

In a similar study having a larger percentage experiencing economics courses, McGuire[70] found only a very minor inverse relationship between enrollment in economics courses and the understanding of economic principles.

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[70] James E. McGuire, "Teaching Basic Production Economic Principles To Secondary School Students of Vocational Agriculture" (unpublished Ph.D. dissertation, Purdue University, 1966), p. 38.

The Number of Teachers in the Vocational Agriculture Department was either one or two. Table 16 shows the percentage of students enrolled in such departments. Approximately two thirds of the participating students in the control and in the pilot-block schools had one teacher in their vocational agriculture department. The percentage having one teacher was increased to 85.2 for the pilot-integrated schools. Overall, 73.3 per cent of the students studied were in a one-teacher department of vocational agriculture.

TABLE 16

PERCENTAGE OF STUDENTS ENROLLED IN ONE OR TWO TEACHER DEPARTMENTS OF VOCATIONAL AGRICULTURE

Group	N	One Teacher	Two Teachers
Control	77	67.5	33.5
Pilot-Block	77	62.3	37.7
Pilot-Integrated	108	85.2	14.8
All Schools	262	73.3	26.7

Table 17 displays the relationship between the mean post-test score of those students who were enrolled in one and two-teacher departments of vocational agriculture. A small positive correlation existed in favor of the two-teacher departments.

It can, therefore, be concluded that students have a slightly higher level of understanding of profit-maximizing principles at two-teacher departments.

TABLE 17

COMPARISON BETWEEN MEANS OF TOTAL POST-TEST SCORES FOR STUDENTS WHO WERE ENROLLED IN ONE OR TWO TEACHER DEPARTMENTS OF VOCATIONAL AGRICULTURE

	Control	Pilot-Block	Pilot-Integrated	All Schools
One-Teacher Department				
N	52	48	92	192
Mean Score	51.3	58.4	58.2	56.4
Two-Teacher Department				
N	25	29	16	70
Mean Score	59.6	66.0	60.1	62.4
Difference in Mean Score	8.3	7.6	1.9	6.0
t =	2.577[a]	1.925	2.008[a]	3.669[b]

[a] Significant at .05 level.

[b] Significant at .01 level.

Teachers Having Received Farm Business Planning and Analysis Instruction was approximately one half. Table 18 reveals that of all participating students, 52.3 per cent of them were taught by teachers who had taken course work in FBPA. Control schools had the highest ratio of students in this category with a percentage of 63.6. The pilot-block group was below the average with only 44.2 per cent.

TABLE 18

PERCENTAGE OF STUDENTS ENROLLED IN DEPARTMENTS WHERE THE TEACHER HAD OR HAD NOT RECEIVED FBPA INSTRUCTION

Group	N	Had	Had Not
Control	77	63.6	36.4
Pilot-Block	77	44.2	55.8
Pilot-Integrated	108	50.0	50.0
All Schools	262	52.3	47.7

Differences between means of total post-test scores for students enrolled in departments where the teacher had or had not received FBPA instruction is shown in Table 19. The t test revealed no significant difference between the scores of either group. There is, however, a very slight indication that pilot school students may have gained by the teacher's experience with FBPA instruction as observed by a positive t value. Control school students, on the other hand, appeared to benefit by their teacher having not received instruction as indicated by a -1.198 value. This might signify that FBPA complemented the use of the instructional units in pilot schools.

TABLE 19

COMPARISON BETWEEN MEANS OF TOTAL POST-TEST SCORES FOR STUDENTS ENROLLED IN DEPARTMENTS WHERE THE TEACHER HAD OR HAD NOT RECEIVED FBPA INSTRUCTION

	Control	Pilot-Block	Pilot-Integrated	All Schools
Had Instruction				
N	49	34	54	137
Mean Score	54.9	60.0	58.4	57.6
Had No Instruction				
N	28	43	54	125
Mean Score	52.4	62.4	58.4	58.4
Difference in Mean Scores	2.5	2.4	0.0	.8
t =	- 1.198	.818	.582	- .488

Teachers Having Coordinated a Farm Business Planning and Analysis Program were fewer in numbers than those having received instruction in this subject matter. Table 20 demonstrates the fact that few teachers went beyond the instruction-receiving stage of the FBPA program. It is noted that of all participating students, only 20.2 per cent were taught farm management by teachers who had coordinated an FBPA program. While a high of approximately one third of the teachers of control school students had coordinated a program, none of the teachers of the pilot-block schools had done so. The comparison between means of total post-test scores for students enrolled in departments where the teacher had or had not conducted an FBPA program is shown in Table 21.

TABLE 20

PERCENTAGE OF STUDENTS ENROLLED IN DEPARTMENTS WHERE THE TEACHER HAD OR HAD NOT COORDINATED AN FBPA PROGRAM

Group	N	Had	Had Not
Control	77	35.1	64.9
Pilot-Block	77	0.0	100.0
Pilot-Integrated	108	24.1	75.9
All Schools	262	20.2	79.8

TABLE 21

COMPARISON BETWEEN MEANS OF TOTAL POST-TEST SCORES FOR STUDENTS ENROLLED IN DEPARTMENTS WHERE THE TEACHER HAD OR HAD NOT COORDINATED AN FBPA PROGRAM

	Control	Pilot-Block	Pilot-Integrated	All Schools
Had Coordinated				
N	27	0.0	26	53
Mean Score	56.4	---	57.8	57.1
Had Not Coordinated				
N	50	77	82	209
Mean Score	52.7	61.3	58.7	58.2
Difference in Mean Scores	3.7	0.0	.9	1.1
t =	1.121	.000[a]	- .248	- .422

[a] Not defined due to lack of comparison.

There was no statistical difference among means of any of the three groups involved in the study as revealed by t values. It is, therefore, concluded that this independent variable had no influence upon student understanding of profit-maximizing principles.

Teacher's Attainment of an Advanced Degree was evident in one third of all observations in the study. Table 22 further reveals that less than this proportion of the students in control and pilot-integrated schools received farm management instruction from teachers who had earned the degree. On the other hand, a Masters degree was held by the teachers of 46.8 per cent of the pilot-block students.

TABLE 22

PERCENTAGE OF STUDENTS ENROLLED IN DEPARTMENTS WHERE THE TEACHER HAD OR HAD NOT ATTAINED AN ADVANCED DEGREE

Group	N	Had	Had Not
Control	77	28.6	71.4
Pilot-Block	77	46.8	53.2
Pilot-Integrated	108	26.9	73.1
All Schools	262	33.2	66.8

Table 23 indicates that the attainment of an advanced degree by teachers had an adverse relationship with student post-test scores. The t test demonstrated a small significant difference between those students whose teachers had the degree and those whose teachers did not. This significance was in favor of no advanced degree at the .05 level with all schools and at the .01 level of confidence with pilot-integrated schools.

TABLE 23

COMPARISON BETWEEN MEANS OF TOTAL POST-TEST SCORES
FOR STUDENTS ENROLLED IN DEPARTMENTS WHERE THE
TEACHER HAD OR HAD NOT ATTAINED
AN ADVANCED DEGREE

	Control	Pilot-Block	Pilot-Integrated	All Schools
Had Degree				
N	22	36	29	87
Mean Score	52.6	64.4	50.9	56.9
Had Not Degree				
N	55	41	79	175
Mean Score	54.4	58.7	61.3	58.4
Difference in Mean Scores	1.8	5.7	10.4	1.5
t =	- .211	- .022	- 3.091[b]	- 2.334[a]

[a] Significant at .05 level.

[b] Significant at .01 level.

The writer theorizes that the reason for this relationship was caused primarily by two factors. First, teachers with Masters degrees were older and had completed their undergraduate work before economic principles were emphasized in their B.S. course of study. Secondly, the typical Masters program does not include study of economics and, therefore, would not improve the teacher's expertise of profit-maximizing principles.

Three-Way Response

Only one independent variable offered a three-way response, that being student year in vocational agriculture. Since three responses were to be studied at the same time, an appropriate statistical technique to determine the significant variation of means among the groups was the F test of one-way analysis of variance.

Student Year in Vocational Agriculture: The instructional units of profit-maximizing principles evaluated through this study were designed for high school juniors and seniors. All participating students met this requisite but were not all in their third or fourth year of vocational agriculture. Students ranged from their first to their fourth year in vocational agriculture with the majority in the latter two grades. Therefore, they were grouped as (a) first or second year, (b) third year, or (c) fourth year. Table 24 lists the percentage of students found in each of the three categories by groups of schools. Nearly one half of all participating students were juniors with 39 per cent seniors and 13 per cent in their first or second year of vocational agriculture. Control schools enrolled the lowest ratio of seniors with a total of 19 per cent. They also registered the highest percentage of first, second, and third year students. Pilot-block schools claimed the most experienced students with 51 per cent being in the fourth year group.

TABLE 24

PERCENTAGE OF STUDENTS ENROLLED IN A GIVEN YEAR OF VOCATIONAL AGRICULTURE BY GROUPS OF SCHOOLS

Control	N	Frist and Second Year	Third Year	Fourth Year
Control	77	19	62	19
Pilot-Block	77	8	53	39
Pilot-Integrated	108	13	36	51
All Schools	262	13	48	39

Table 25 shows the comparison among mean total post-test scores and students' year in vocational agriculture. Scores are listed by groups of schools for each year category. A significant difference within the pilot-integrated group and for all schools combined was revealed by F values. The former group was significant at the .05 level whereas the latter group stands significant at the .01 level of confidence. This information is interpreted as meaning that the more years of vocational agriculture experience, the greater is one's understanding of profit-maximizing principles. McGuire[71] found a similar situation in his study of production economic principles at Purdue University.

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[71] Ibid., p. 38.

TABLE 25

COMPARISON BETWEEN MEANS OF TOTAL POST-TEST SCORES AND STUDENTS' YEAR IN VOCATIONAL AGRICULTURE

	Control	Pilot-Block	Pilot-Integrated	All Schools
First and Second Year				
N	15	6	14	35
Mean Score	48.0	60.7	48.4	50.2
Third Year				
N	47	41	39	127
Mean Score	55.8	58.0	56.2	56.7
Fourth Year				
N	15	30	55	100
Mean Score	54.2	66.0	62.7	62.4
F =	1.513	1.969	4.759[a]	8.025[b]

[a] Significant at .05 level.

[b] Significant at .01 level.

Multiple Response

Five independent variables were classified as having multiple or interval scale response. To statistically measure the association of these independent variables, the Pearsonian product-moment correlation coefficient r was considered to be most useful. For this reason it was applied to determine the relative association of given values of each independent variable with student understanding of profit-maximizing principles as measured by the post-test. The following items were classified as multiple response independent variables.

1. Student year of farm experience.
2. Student I.Q.
3. College quarter hours of economics instruction received by the teacher.
4. Teacher's years of teaching experience.
5. Hours of instructional time used.

Student Years of Farm Experience ranged from 0 to 4. The specific number was determined by the years of actual farm experience while the student attended high school. Therefore, if the individual was a junior and had worked on a farm since entering high school, he was considered to have 3 years of farm experience. Seniors likewise would have 4 years experience. Experience before entering high school was not considered in the study. In some cases the student had no farm experience, while in other instances experience might have started late in his high school career. Table 26 lists the mean years of farm experience for each of the control and pilot groups involved in this study. The overall mean years for all participating groups was 3.13 with a standard deviation of 1.05 years. This connotes that the average student was between his third and fourth year of farm experience with two thirds of all students within the range of one year of this figure. Students enrolled at control schools had the least experience with 2.81 years while the pilot-block students averaged a high of 3.40 years. The pilot-block schools also boasted of the most homogeneous grouping with a standard deviation of .80 about the mean.

TABLE 26

CORRELATION BETWEEN STUDENT YEARS OF FARM EXPERIENCE AND MEAN POST-TEST SCORES

Group	N	Mean Years	Standard Deviation	Post-Test Score	r Value
Control	77	2.81	1.03	54.0	.264[a]
Pilot-Block	77	3.40	.80	61.3	.251[a]
Pilot-Integrated	108	3.18	1.16	58.4	.293[b]
All Schools	262	3.18	1.05	58.0	.297[b]

[a] Significant at .05 level.

[b] Significant at .01 level.

Correlations between student years of farm experience and mean post-test scores are also depicted in Table 26. The Pearsonian r values derived show a low correlation, yet significant at the .05 level of confidence between the two factors. These values were relatively constant for all three groups with a slightly higher r assigned to pilot-integrated students. This is interpreted to mean that the more farm experience a student possesses, the chance of his obtaining a higher post-test score is only slight.

Student I.Q. scores were averaged for each group of students participating in the study. These averages were derived from several different intelligence tests as discussed in Chapter II. Scores were equated within each group as obtained from respective schools and posted as displayed in Table 27. It may be noted that mean I.Q. scores for pilot and control schools were very similar with an all school average of 102.1. Pilot-block schools showed the greatest mean I.Q. score and standard deviation with values of 103.1 and 15.63 respectively. This I.Q. score was only 1.7 points above the lowest mean of 101.4 achieved by control schools.

TABLE 27

CORRELATION BETWEEN STUDENT I.Q. AND MEAN POST-TEST SCORES

Group	N	Mean I.Q.	Standard Deviation	Post-Test Score	r Value
Control	77	101.4	12.92	54.0	.535[a]
Pilot-Block	77	103.1	15.63	61.3	.737[a]
Pilot-Integrated	108	101.2	13.31	58.4	.593[a]
All Schools	262	102.1	13.88	58.0	.624[a]

[a] Significant at .01 level.

Table 27 furthermore shows the relationship between student I.Q. scores and mean post-test scores for each group. Pearsonian r values listed demonstrate a moderate correlation which is significant at the .01 level of confidence for all groups. Pilot-block schools achieved the highest post-test score of 61.3 which proved to have the greatest correlation with I.Q. scores for the group with an r value of .737. Control schools, on the other hand, had the lowest mean post-test score of 54.0 together with the least relationship with I.Q. as revealed with the r value of .535. This information indicates that a student's I.Q. is associated with his understanding of profit-maximizing principles but only at a moderate level.

College Quarter Hours of Economics Instruction Received by the Teachers of each group and their correlation with mean post-test scores are shown in Table 28.

TABLE 28

CORRELATION BETWEEN COLLEGE QUARTER HOURS OF ECONOMICS INSTRUCTION RECEIVED BY TEACHERS AND MEAN POST-TEST SCORES

Group	N	Mean Quarter Hours of Economics	Standard Deviation	Post-Test Score	r Value
Control	77	13.13	4.00	54.0	.136
Pilot-Block	77	25.90	8.08	61.3	-.278[a]
Pilot-Integrated	108	22.96	9.33	58.4	.086
All Schools	262	20.94	9.29	58.0	.075

[a] Significant at .05 level.

Of all teachers involved in the study, an average of nearly 21 quarter hours of economics instruction was received. This was an accumulation of all economics courses taken from either business or agricultural economics areas since the beginning of the teacher's college career. There was a wide range of economic course experience among teachers within each group as depicted by a standard deviation of 9.29 for all schools. The control schools showed a marked difference in attainment of economics courses with a mean of only 13.13 quarter hours and a lower standard deviation of 4.00. Correlation between quarter hours of economics instruction received and mean student post-test scores achieved by all groups was not significant as indicated by r value of .075 listed in the table. It is observed that the pilot-block group with the greatest accumulation of economics instruction (25.90 quarter hours) also achieved the highest post-test score (61.3) yet received a negative r value. This value was significant at the .05 level. These findings indicate that this independent variable was not responsible for the pilot-block group achieving the highest mean post-test score.

Teachers' Years of Teaching Experience was considered in the study as an influencing factor on student understanding of profit-maximizing principles. Table 29 lists the mean years of teaching experience for each group of teachers. Teachers of control schools greatly exceeded both pilot groups in teaching experience with an average of 18.48 years. They also had the greatest range of years of experience with a standard deviation of 11.04 compared with just over 6 for the pilot groups. Pilot-integrated schools were the lowest in experience with a mean of nearly 9 years. The all school average was the same as pilot-block schools with nearly 13 years of experience. Table 29 also shows a negative r value of correlation between teaching experience and mean post-test scores for all groups.

TABLE 29

CORRELATION BETWEEN TEACHERS' YEARS OF TEACHING EXPERIENCE AND MEAN POST-TEST SCORES

Group	N	Mean Years Teaching Experience	Standard Deviation	Post-Test Score	r Value
Control	77	18.48	11.04	54.0	-.167
Pilot-Block	77	12.94	6.56	61.3	-.227
Pilot-Integrated	108	8.97	6.13	58.4	-.293[b]
All Schools	262	12.93	8.89	58.0	-.240[a]

[a] Significant at .05 level.

[b] Significant at .01 level.

The all school average, and the pilot-integrated group average revealed a low correlation with r values of -.240 and -.293 respectively which are both statistically significant at the .05 level of confidence. This information indicates that the less experienced teachers were able to teach their students the understanding of profit-maximizing principles at a more effective level than the teachers with greater years of teaching experience. The reason for this relationship may be accounted for primarily by two factors. The younger teachers had experienced more concentrated study of economic principles in their training. Secondly, younger teachers tended to adjust their teaching procedures to the instructional units to a greater extent than did older teachers.

Hours of Instructional Time Used in teaching farm management ranged a great deal both within and among the three groups of this study. The difference is evidenced in Table 30 where control schools showed a high mean of 42.23 hours with a very high standard deviation of 24.07.

TABLE 30

CORRELATION BETWEEN HOURS OF INSTRUCTIONAL TIME USED AND MEAN POST-TEST SCORES

Group	N	Mean Time Used	Standard Deviation	Post-Test Score	r Value
Control	77	42.23	24.07	54.0	-.159
Pilot-Block	77	27.12	4.94	61.3	-.108
Pilot-Integrated	108	33.03	13.10	58.4	.266[a]
All Schools	262	30.00	16.75	58.0	-.043

[a] Significant at .01 level.

Pilot-integrated schools used a mean of 33 hours of instructional time to cover the instructional units whereas pilot-block schools used only a mean of 27 hours. The latter group of schools was more consistent than other schools in time requirement as demonstrated by a standard deviation of 4.94. Correlations between hours of instructional time and student post-test scores are also shown in Table 30. With the exception of the pilot-integrated schools, there was no significant relationship between the two factors as evidenced by r values. Pilot-integrated schools displayed a low correlation of .266 which indicates only a small relationship. Although a great variation of instructional time was used by participating schools, it may be concluded that it had little or no influence upon post-test scores attained by students.

Incomplete Response

Only one independent variable received incomplete responses. This was because this item was attached to the study while it was in progress. Data was, therefore, gathered from only a portion of the participating schools. Responses were on an interval level of measure which suggests the use of the Pearsonian product-moment correlation coefficient r.

Local grades were obtained from 15 participating schools which enrolled 189 students. These grades were those achieved by students on exams designed and administered by participating teachers pursuant to the subject matter taught during the instructional unit trial period. Table 31 lists the mean local grade assigned to each control and pilot group. It is noted that local grades were procured from 5 participating schools from each group with an analogous number of students. Grades were similar with a low mean of 70 for the pilot-block group. This group also had by far the highest standard deviation which registered at 22.31. The total all school mean local grade score was 77 with a standard deviation of 15.50.

TABLE 31

MEAN LOCAL GRADES ASSIGNED BY SELECTED PARTICIPATING TEACHERS

Group	School N	Student N	Mean Grade	Standard Deviation
Control	5	72	79	10.07
Pilot-Block	5	57	70	22.31
Pilot-Integrated	5	61	80	10.65
All Schools	15	189	77	15.50

Correlation between local grades and mean post-test scores for each group involved in the study are shown in Table 32. For all schools combined there was no significant relationship. Pilot-block schools, however, did show a small relationship with an r value of .284 which was found to be significant at the .05 level of confidence. It is interesting to note that there was a much stronger relationship between local grades and post-test scores when these two items were compared within the three individual groups participating in the study. In fact, the correlation was significant at the .01 level for most groups when comparing local grades with post-test scores on each specific profit-maximizing principle. The wide range between the r values reported here and those reported for the three major groups (reported later under objective three) is primarily due to the unequal bases of grading among schools. This point is demonstrated with pilot-block schools which had the lowest local grade, yet the highest post-test grade. It is, therefore, concluded that there was a significant correlation between the two exams within the individual schools although it did not appear to be so when all schools were combined as in Table 45.

TABLE 32

CORRELATION BETWEEN LOCAL GRADES AND MEAN POST-TEST SCORES OF SELECTED PARTICIPATING STUDENTS

Group	Student N	Post-Test Score	Standard Deviation	r Value
Control	72	53.3	7.37	.128
Pilot-Block	57	62.9	14.15	.284[a]
Pilot-Integrated	61	58.2	8.73	.067
All Schools	189	60.2	15.80	.091

[a] Significant at .05 level.

Summary of Objective Two Accomplishment

Objective two of this study was to determine the relationship between the dependent variable of student understanding of profit-maximizing principles as measured by the post-test and thirteen independent variables.

Of the thirteen independent variables, four proved not to be significantly related to student post-test scores. They were:

1. Student year in high school.
2. Economic courses taken by students in high school.
3. Teachers having received Farm Business Planning and Analysis instruction.
4. Teacher having coordinated a Farm Business Planning and Analysis program.

Three independent variables showed a very minor degree of relationship. In each case only one group of the three within the study, i.e. control, pilot-block, or pilot-integrated, proved to be significant at the .05 level of confidence. It is concluded that these independent variables would tend not to be reliable in predicting post-test scores. The variables in this classification were:

1. College quarter hours of economics instruction received by the teacher.
2. Hours of instructional time used.
3. Local grades.

The remaining six independent variables tended to be more closely associated with total post-test scores achieved by participating students. However, these presented only a low degree of relationship.

These independent variables were:

1. Student year in vocational agriculture.
2. Student years of farm experience.
3. Student I.Q.
4. Number of teachers in the vocational agriculture department.
5. Teacher's years of teaching experience.
6. Teacher's attainment of an advanced degree.

Post-test scores indicated that the more years of vocational agriculture experience the greater one's understanding was of profit-maximizing principles. This factor was significant at the .01 level for all schools combined and at the .05 level for the pilot-integrated group. Farm experience appeared valuable to students in their understanding of economic principles. Those with the greatest number of years obtained a significantly higher score on the post-test for all three groups. For all schools combined the relationship was at the .01 level of confidence. Student I.Q. proved to be the most reliable predictor of post-test scores. The highest correlation was obtained between I.Q. scores and test scores of any of the thirteen independent variables. The relationship was significant for all three groups at the .01 level. Students in two-teacher vocational agriculture departments tended to achieve higher post-test scores than those in single teacher departments. These values were significant at the .05 level for two groups and at the .01 level for all schools combined. Teacher attainment of an advanced degree as well as greater years of teaching experience resulted in a small inverse relationship with student achievement on the post-test. Both of these independent variables were significant at the .05 level for all schools combined with one group each revealing a significance at the .01 level of confidence.

Because of the findings of this experimental study, the second null hypothesis established in Chapter I was rejected. It stated that there would be no relationship between the independent variables and the dependent variable of student understanding of profit-maximizing principles. Some relationships were found to exist; therefore, forcing the researcher to refuse the null hypothesis.

Relationship Between Student Understanding of Each Profit-Maximizing Principle And The Independent Variables

Objective three of this study was to determine the effects of the thirteen independent variables upon student understanding of each of the profit-maximizing principles pertaining to the seven instructional units. In analyzing these effects, the post-test scores concerning each unit were compared with the independent variables. The same basic procedures were used as employed in objective two where total post-test scores were compared with each independent variable.

To obtain an overview of the general effect of the independent variables upon student understanding of the individual instructional units, they were all subjected to the Pearsonian product-moment correlation coefficient r. A complete list of correlation coefficients for each independent variable and individual instructional units is located in Appendix F. Following this action, the thirteen independent variables were grouped into four subsets to more closely analyze their association with specific units. As previously stated, this grouping was structured because of difference in levels of measurement among the independent variables, thus requiring divergent statistical techniques in working with smaller numbers to more precisely determine significant influences upon student achievement. The subsets and statistical technique for each were:

1. Two-way response--t test.
2. Three-way response--F test.
3. Multiple response--Pearson r.
4. Incomplete response--Pearson r.

In reporting the accomplishments of objective three, the writer has refrained from lengthy discussion and duplication of results reported earlier pursuant to objective two. The thirteen independent variables are investigated separately on individual tables and categorized by subsets. These tables list values of the comparisons among each independent variable and each instructional unit by groups of participating schools. Numbers of students in respective categories and associated post-test grades are not listed. Reference may be made to tables concerning objective two for further insight on this information.

Two-Way Response

Six independent variables dealt with two-way response. The t test was employed to determine the significant difference between the means of the two groups who responded either positively or negatively. The results of the effects of the six independent variables are listed in the following tables and discussed briefly.

Student Year in High School: Table 33 refers to t value comparisons between mean test scores on each instructional unit for students enrolled in their junior or senior year of high school. Only in unit two did a significant difference between mean scores develop. These differences were located within the pilot-block group and in all schools combined with t values of -2.188 and -2.142 respectively. The minus sign indicates that the difference was in favor of juniors. These two values were only at the .05 level of confidence which could have been expected by chance alone with the large number of statistical tests listed. It is, therefore, concluded that it makes little or no difference at what grade level farm management by any of the three techniques is taught.

TABLE 33

t VALUE COMPARISONS BETWEEN MEAN TEST SCORES ON EACH INSTRUCTIONAL UNIT FOR STUDENTS ENROLLED IN THEIR JUNIOR OR SENIOR YEAR OF HIGH SCHOOL

Unit	Control	Pilot-Block	Pilot-Integrated	All Schools
1	1.315	-1.278	1.091	- .297
2	.506	-2.188[a]	.391	-2.142[a]
3	1.415	- .109	.492	.700
4	.034	.339	- .300	- .512
5	.080	- .717	.401	- .380
6	.447	- .690	.866	.197
7	.318	-1.320	- .344	- .375
All	.561	-1.137	.521	- .568

[a] Significant at .05 level.

Economic Courses Taken by Students in High School: t value comparisons are located in Table 34 showing the relationship between each unit test score and groups who had or had not taken an economics course in high school. Only three instances of significant difference appeared. Of these three, two were in the pilot-block group with units three and six. The third was located in the pilot-integrated group with unit two. Generally, it may be concluded that there was no significant difference between means of those who had taken economics and those who had not.

TABLE 34

t VALUE COMPARISONS BETWEEN MEAN TEST SCORES ON EACH INSTRUCTIONAL UNIT FOR STUDENTS WHO HAD AND THOSE WHO HAD NOT ENROLLED IN AN ECONOMICS COURSE

Unit	Control	Pilot-Block	Pilot-Integrated	All Schools
1	- .988	.977	- .489	.070
2	-1.491	.106	-2.199[a]	-1.365
3	-1.999[a]	.722	- .399	- .443
4	- .740	1.160	- .013	.105
5	- .341	.986	- .467	- .065
6	-3.229[b]	.720	- .863	-1.309
7	- .698	- .656	.713	.220
All	-1.964	.864	- .693	- .538

[a] Significant at .05 level.

[b] Significant at .01 level.

Number of Teachers in the Vocational Agriculture Department: Table 35 lists t values for this independent variable. Here the comparison is between mean test scores concerning each unit for students who were enrolled in a one or in a two-teacher department. Again, for this variable only three significant differences appeared. And again, they were restricted to the control and the pilot-integrated schools. However, when all schools are combined, significant differences between means of those in one-teacher departments and those in two-teacher departments become prevalent. For three units this difference is at the .01 level and for three more it exists at the .05 level of confidence in favor of two-teacher departments. It is thus concluded that students enrolled in two-teacher departments obtained a higher level of understanding of profit-maximizing principles than did those individuals studying at single-teacher departments.

TABLE 35

t VALUE COMPARISONS BETWEEN MEAN TEST SCORES ON EACH INSTRUCTIONAL UNIT FOR STUDENTS WHO WERE ENROLLED IN ONE OR TWO TEACHER DEPARTMENTS OF VOCATIONAL AGRICULTURE

Unit	Control	Pilot-Block	Pilot-Integrated	All Schools
1	1.774	.991	2.215[a]	3.292[b]
2	1.718	1.380	2.093[a]	3.608[b]
3	1.371	.831	1.836	2.717[b]
4	1.281	- .641	1.741	2.223[a]
5	1.105	.914	1.099	2.555[a]
6	3.369[b]	.509	- .090	2.437[a]
7	1.767	1.446	1.068	1.282
All	2.577[a]	1.925	2.008[a]	3.669[b]

[a] Significant at .05 level.

[b] Significant at .01 level.

Teachers Having Received Farm Business Planning and Analysis Instruction: Table 36 reveals the t value comparisons between mean test scores on each instructional unit for students enrolled in departments where the teacher had or had not received FBPA instruction. With the exception of one observation, no significant difference between means for the two categories existed. For this reason it is concluded that this variable had no influence upon student understanding of any of the instructional units.

TABLE 36

t VALUE COMPARISONS BETWEEN MEAN TEST SCORES ON EACH INSTRUCTIONAL UNIT FOR STUDENTS ENROLLED IN DEPARTMENTS WHERE THE TEACHER HAD OR HAD NOT RECEIVED FBPA INSTRUCTION

Unit	Control	Pilot-Block	Pilot-Integrated	All Schools
1	.887	1.044	.952	.427
2	.605	1.450	.883	- .290
3	- .867	.738	1.110	.612
4	-1.201	.127	.149	- .529
5	- .297	1.184	- .215	- .527
6	-2.968[b]	- .062	- .338	-1.522
7	- .379	.463	.320	- .632
All	-1.198	.818	.582	- .488

[b] Significant at .01 level.

Teacher Having Coordinated a Farm Business Planning and Analysis Program: In only two cases did a significant difference between means appear for this variable. Table 37 shows the various t values comparing test score means of those students who were enrolled in departments where the teacher had or had not coordinated an FBPA program. Since t values for this independent variable were so minor it is concluded that teacher experience in coordinating or not coordinating an FBPA program was not associated with student understanding of profit-maximizing principles.

TABLE 37

t VALUE COMPARISONS BETWEEN MEAN TEST SCORES ON EACH INSTRUCTIONAL UNIT FOR STUDENTS ENROLLED IN DEPARTMENTS WHERE THE TEACHER HAD OR HAD NOT COORDINATED A FBPA PROGRAM

Unit	Control	Pilot-Block	Pilot-Integrated	All Schools
1	2.446[a]	1.209	.332	.721
2	.082	2.131[a]	- .013	- .518
3	1.030	.349	- .554	- .575
4	.574	- .542	-1.447	-2.272[a]
5	.487	.658	.668	.035
6	.665	- .472	.014	.086
7	1.205	- .100	- .105	.868
All	1.121	.631	- .248	- .422

[a] Significant at .05 level.

Teacher Attainment of an Advanced Degree: Table 38 displays t value comparisons between mean test scores on each instructional unit for students enrolled in departments where the teacher had or had not attained an advanced degree.

TABLE 38

t VALUE COMPARISONS BETWEEN MEAN TEST SCORES ON EACH INSTRUCTIONAL UNIT FOR STUDENTS ENROLLED IN DEPARTMENTS WHERE THE TEACHER HAD OR HAD NOT ATTAINED AN ADVANCED DEGREE

Unit	Control	Pilot-Block	Pilot-Integrated	All Schools
1	-1.126	1.026	-2.564[a]	-1.651
2	- .650	.274	-1.639	-1.100
3	- .552	-1.281	-2.999[b]	-3.539[b]
4	.926	.168	-2.564[a]	-1.811
5	.327	.322	-2.853[b]	-1.786
6	.062	- .713	- .587	-1.109
7	- .502	.653	-1.914	- .361
All	- .211	- .022	-3.091[b]	-2.334[a]

[a] Significant at .05 level.

[b] Significant at .01 level.

Four of the instructional units show a significant negative difference between means within the pilot-integrated group. Two of these values are at the .05 level and two at the .01 level. This difference is in favor of students whose teacher did not have an advanced degree. Unit three revealed a difference at the .01 level both within the pilot-integrated group and for all schools combined. It is, therefore, concluded that the attainment of an advanced degree did have a minor negative association with student understanding of profit-maximizing principles.

Three-Way Response

One independent variable dealt with a three-way response. This item was student year in vocational agriculture. The F test was employed to determine the significant variation of means among the three categories.

Student Year in Vocational Agriculture: Table 39 shows F value comparisons among mean test scores on each instructional unit and the student's year in vocational agriculture. The student was classified as (a) being in his first two years, (b) in his third, or (c) in his fourth year. Sporadic significant variations appear within the various units with units three and five each revealing influence from the independent variable in two of the major groups of schools. For all schools combined, there is a significant variation within units three, four, and five at the .01 level with F values of 10.092, 5.556, and 8.709 respectively. This indicates that there is a definite influence of student year in vocational agriculture and his achievement in understanding of specific profit-maximizing principles. The association between the two items is in favor of the students with the greatest experience in vocational agriculture.

TABLE 39

F VALUE COMPARISONS AMONG MEAN TEST SCORES ON EACH INSTRUCTIONAL UNIT AND STUDENT'S YEAR IN VOCATIONAL AGRICULTURE

Unit	Control	Pilot-Block	Pilot-Integrated	All Schools
1	.067	.252	1.404	1.608
2	.826	.956	1.105	2.476
3	3.823[a]	1.694	6.639[b]	10.092[b]
4	2.580	2.998	1.417	5.556[b]
5	.508	3.689[a]	3.764[a]	8.709[b]
6	.718	.972	1.388	2.735
7	1.296	1.463	5.884[b]	3.743
All	1.513	1.969	4.759[a]	8.025[b]

[a] Significant at .05 level.

[b] Significant at .01 level.

Multiple Response

Five independent variables offered multiple or interval scale response. The Pearsonian product-moment correlation coefficient r was employed with these independent variables to determine their correlation with student test scores concerning each instructional unit.

Student Years of Farm Experience: Table 40 indicates Pearson r correlation values between student year of farm experience and mean test scores on each instructional unit. There appears to be a low correlation yet a definite relationship between the two factors. Significant differences between means are located mostly within the pilot-integrated schools. For all schools combined, significant differences appear for units 3, 4, 5, and 7. The latter two are significant at the .01 level of confidence. It is concluded that farm experience does have a slight relationship with student understanding of profit-maximizing principles.

TABLE 40

PEARSON r CORRELATION VALUES BETWEEN STUDENT YEAR OF FARM EXPERIENCE AND MEAN TEST SCORES ON EACH INSTRUCTIONAL UNIT

Unit	Control	Pilot-Block	Pilot-Integrated	All Schools
1	.027	.083	.267[b]	.190
2	.071	.235[a]	.176	.192
3	.294[a]	.172	.231[a]	.256[b]
4	.339[b]	.274[a]	.178	.280[b]
5	.161	.220	.234[a]	.237[a]
6	.076	.125	.109	.114
7	.214	.166	.264[b]	.205[a]
All	.264[a]	.251[a]	.293[b]	.297[b]

[a] Significant at .05 level.

[b] Significant at .01 level.

Student I.Q.: Influences of student I.Q. upon test scores on each instructional unit are depicted in Table 41. Pearson r values indicate a low to moderate correlation between test scores and I.Q. ratings for all units with significant correlation for all observations except unit 7 in the control group. Student I.Q. was as closely related to student understanding of profit-maximizing principles as any of the thirteen independent variables. It is concluded that this independent variable was associated with student achievement at a moderate degree for all instructional units.

TABLE 41

PEARSON r CORRELATION VALUES BETWEEN STUDENT I.Q. AND MEAN TEST SCORES ON EACH INSTRUCTIONAL UNIT

Unit	Control	Pilot-Block	Pilot-Integrated	All Schools
1	.320[b]	.516[b]	.458[b]	.445[b]
2	.249[a]	.499[b]	.455[b]	.413[b]
3	.362[b]	.630[b]	.260[b]	.398[b]
4	.548[b]	.613[b]	.582[b]	.576[b]
5	.480[b]	.475[b]	.316[b]	.409[b]
6	.285[a]	.548[b]	.503[b]	.461[b]
7	.216	.513[b]	.388[b]	.375[b]
All	.535[b]	.737[b]	.593[b]	.624[b]

[a] Significant at .05 level.

[b] Significant at .01 level.

College Quarter Hours of Economics Instruction Received by the Teacher: Table 42 reveals correlation values between college quarter hours of economics instruction received by teachers and mean test scores on each instructional unit obtained by their students.

TABLE 42

PEARSON r CORRELATION VALUES BETWEEN COLLEGE QUARTER HOURS OF ECONOMICS INSTRUCTION RECEIVED BY TEACHERS AND MEAN TEST SCORES ON EACH INSTRUCTIONAL UNIT

Unit	Control	Pilot-Block	Pilot-Integrated	All Schools
1	.246[a]	-.163	.128	.126
2	.179	-.173	.050	.102
3	.069	-.266[a]	.089	.054
4	.014	-.215	.098	.091
5	.066	-.227	.012	.056
6	.059	-.220	-.026	-.024
7	.045	-.170	.037	-.052
All	.136	-.278[a]	.086	.075

[a] Significant at .05 level.

With the exception of only two observations, one in unit 1 and one in unit 3, there was no significant correlation within the instructional units. It is noted that a negative correlation appeared for all units within the pilot-block group resulting in a -.278 r value for all units combined. This indicates an inverse relationship between quarter hours of economics instruction and student test achievement. However, for all units combined, there was no correlation between the two factors within the all school rating indicating that difference in college economics instruction received by teachers had no relationship to student achievement.

Teachers' Years of Teaching Experience: Correlation values between teachers' years of teaching experience and mean test scores on each instruction unit are displayed in Table 43. There appears to be a low correlation between the two factors for specific groups within units 1, 2, 3, and 5. Three of these are concentrated within the pilot-integrated group of schools. A low negative correlation existed within groups of schools but not within individual instructional units. This is interpreted as meaning that there was greater association within groups of schools than within the instructional units. It is concluded that the number of years of teaching experience has little if any influence upon student understanding of specific profit-maximizing principles. This conclusion does not carry the impact that its corresponding one did in objective two, where it was implied that the less experienced teachers were more effective in relating the understanding of economic principles to their students.

TABLE 43

PEARSON r CORRELATION VALUES BETWEEN TEACHER'S YEARS OF TEACHING EXPERIENCE AND MEAN TEST SCORES ON EACH INSTRUCTIONAL UNIT

Unit	Control	Pilot-Block	Pilot-Integrated	All Schools
1	-.241[a]	-.151	-.278[b]	.045
2	-.139	-.173	-.199[a]	-.032
3	-.141	-.201	-.332[b]	-.036
4	.009	-.126	-.176	-.140
5	-.072	-.250[a]	-.138	.002
6	-.166	-.183	-.169	.005
7	-.103	-.081	-.157	.054
All	-.167	-.227	-.293[b]	-.240[a]

[a] Significant at .05 level.

[b] Significant at .01 level.

Hours of Instructional Time Used: Table 44 lists correlation values between hours of instructional time used and mean test scores on each instructional unit. Pearson r values for units 2, 3, 5, and 6 indicate a low significant relationship between the two factors. These observations are concentrated in the pilot-integrated group of schools showing a positive association whereas a negative association exists in the other two groups of schools. No significant correlation existed for any of the instructional units for all schools combined. It is, therefore, concluded that in general, hours of instructional time used in teaching farm management had no significant association with student understanding of any of the profit-maximizing principles.

TABLE 44

PEARSON r CORRELATION VALUES BETWEEN HOURS OF INSTRUCTIONAL TIME USED AND MEAN TEST SCORES ON EACH INSTRUCTIONAL UNIT

Unit	Control	Pilot-Block	Pilot-Integrated	All Schools
1	-.003	-.093	.155	-.010
2	-.098	-.263[a]	.212[a]	-.075
3	-.146	-.037	.210[a]	-.032
4	-.075	.109	.179	-.037
5	-.042	-.042	.269[b]	.008
6	-.323[b]	-.175	.207[a]	-.093
7	-.068	-.076	.102	.029
All	-.159	-.108	.266[b]	-.043

[a] Significant at .05 level.

[b] Significant at .01 level.

Incomplete Response

One independent variable received incomplete responses because of being added to the study while it was in progress. For this reason, all students from all participating schools are not represented within this independent variable. Since the data gathered pursuant to this independent variable was of an interval level of measure, the Pearson r statistic was used to determine degrees of relationship.

Local Grades: Pearson r correlation values between local grades and mean test scores on each instructional unit are located in Table 45.

TABLE 45

PEARSON r CORRELATION VALUES BETWEEN LOCAL GRADES AND MEAN TEST SCORES ON EACH INSTRUCTIONAL UNIT

Unit	Control	Pilot-Block	Pilot-Integrated	All Schools
1	.483[b]	.527[b]	.354[b]	.400[b]
2	.442[b]	.748[b]	.506[b]	.464[b]
3	.510[b]	.711[b]	.415[b]	.479[b]
4	.486[b]	.542[b]	.515[b]	.434[b]
5	.243[a]	.450[b]	.464[b]	.373[b]
6	.474[b]	.232	.420[b]	.255[a]
7	.232	.201	.251	.105
All	.128	.284[a]	.067	.091

[a] Significant at .05 level.

[b] Significant at .01 level.

With the exception of unit 7 there was a strong correlation between the two factors which for most observations were significant at the .01 level of confidence. This would indicate that exams designed by participating teachers tended to discriminate among levels of student understanding of concepts of farm management at nearly the same degree as did the post-test. It is interesting to note that correlations within specific units for individual groups of schools showed a stronger relationship than they did for all observations combined. This result was due to the inconsistent bases for grading among participating schools.

Summary of Objective Three Accomplishment

Objective three of this study was to determine the association of the thirteen independent variables with student understanding of each of the profit-maximizing principles pertaining to the seven instructional units.

Analysis of the effects of the independent variables upon student understanding of individual profit-maximizing principles revealed similar results as were found when total post-test scores were compared with each independent variable.

Of the thirteen independent variables, six proved to be statistically non-significant in association with student test scores on individual instructional units. The six were:

1. Student year in high school.
2. Economics courses taken by students in high school.
3. College quarter hours of economics instruction received by the teacher.
4. Teachers having received Farm Business Planning and Analysis instruction.

5. Teachers having coordinated a Farm Business Planning and Analysis program.
6. Hours of instructional time used.

Two independent variables showed a very minor negative relationship. In both cases significant values were only sporadic and would, therefore, be unreliable predictors of test scores on individual instructional units. These independent variables were:

1. Teachers' years of teaching experience.
2. Teacher's attainment of an advanced degree.

The remaining five independent variables displayed a greater degree of association with test scores concerning specific instructional units. It is noted, however, that influence from these factors is relatively low. They were:

1. Student year in vocational agriculture.
2. Student years of farm experience.
3. Student I.Q.
4. Number of teachers in vocational agriculture department.
5. Local grades.

Unit test scores indicated that the more years of vocational agriculture experience, the greater the student's understanding was of individual profit-maximizing principles. Units 3, 4, and 5 proved significant at the .01 level of confidence for all schools combined. Greater farm experience seemed to be associated slightly with student achievement on unit tests. Correlation between test scores and farm experience was significant for units 3, 4, 5, and 7 for all schools combined with the former two significant at the .01 level. Student I.Q. proved to have a higher degree of correlation with unit test scores. A moderate relationship existed at the .01 level for all 7 units with all schools combined and for the most part for all three individual groups. Students studying at two-teacher departments of vocational agriculture tended to obtain higher unit scores than those at single-teacher departments. For all schools combined this factor proved significant for units 1, 2, 3, 4, 5, and 6. The first three were significant at the .01 level. There was a definite correlation between unit scores and grades assigned to students at their local school. With the exception of unit 7, significant correlation appeared among all instructional units. The first five units were significant at the .01 level of confidence for all schools combined. Close correlation was exhibited within each group of students for most instructional units.

Null hypothesis number three as established in Chapter I stated that there would be no effects of the independent variables upon student understanding of each profit-maximizing principle. Since some association was found between the two factors, this null hypothesis was rejected.

Chapter Summary

This chapter dealt with the statistical analysis of data obtained in the pursuit of measuring the relative effectiveness of the seven instructional units concerning profit-maximizing principles. Appraisal of the units was accomplished through the utilization of three different groups of vocational agriculture students who were taught farm management by different techniques. The pilot-block group and the pilot-integrated group received instruction from the developed instructional units while the control group was taught by the traditional manner of teaching farm management.

Analysis of data was accomplished through the employment of several statistical means. The F test followed by the Duncans multiple range statistic was used to determine which of the three groups involved in the study achieved the highest level of understanding of profit-maximizing principles. To determine the significance of thirteen independent variables in influencing student achievement, the Pearsonian r, the F and the t test were used.

In achieving objective one of the study, it was found that the pilot-block group excelled both the pilot-integrated and the control groups. Mean scores obtained on the post-test were 61.3, 58.4, and 54.0 respectively. The pilot-block group also exceeded the others in understanding of most of the individual profit-maximizing principles. It was, therefore, concluded that the developed instructional units did enhance understanding of profit-maximizing principles beyond the traditional manner of teaching farm management to students of vocational agriculture. It was furthermore concluded that the most effective method of using the units was by the block technique whereby no other subject matter was integrated.

Results obtained in achieving objectives two and three of the study demonstrated the association of thirteen independent variables with student understanding of profit-maximizing principles. Objective two was concerned with independent variable association with total post-test scores covering all instructional units whereas objective three dealt with test scores achieved on specific questions pertaining only to individual instructional units. Statistical analysis showed that four independent variables had no association with student understanding of profit-maximizing principles with all units combined or when individual units were analyzed separately. These were:

1. Student year in high school.
2. Economics courses taken by students in high school.
3. Teacher having received FBPA instruction.
4. Teacher having coordinated an FBPA program.

Five independent variables showed inconsistent minor influence upon student understanding. While some displayed no association with individual units, they proved to be associated with total post-test scores and vice versa. Differences in numbers of students dealt with and the inconsistency among teachers and schools appeared to cause this relationship. These independent variables were:

1. College quarter hours of economics instruction

received by the teacher.

2. Teacher's years of teaching experience.
3. Teacher's attainment of an advanced degree.
4. Hours of instructional time used.
5. Local grades.

The remaining four independent variables consistently showed some association with student understanding of individual principles and all units combined. These independent variables were:

1. Student year in vocational agriculture.
2. Student years of farm experience.
3. Student I.Q.
4. Number of teachers in vocational agriculture department.

Because of the results of this experimental study, all null hypotheses established in Chapter I were rejected.

CHAPTER IV

TEACHER EVALUATION OF INSTRUCTIONAL UNITS

Innovations in instructional materials must be evaluated to determine their worth. Without this crucial phase in the development of a new emphasis in the vocational agriculture curriculum, little would be known of its true effectiveness in improving teaching and learning. Evaluation of the developed instructional units of profit-maximizing principles involved teachers as well as students. Students participated in appraising the units through the post-test which measured their level of understanding of the given principles. Teachers were involved in evaluation of the units, for it was believed by the writer that their guidance and influence was essential in establishing and disseminating effective instructional units.

Evaluation is the action of comparing the actual with the ideal. It is ". . .the process of measuring effectiveness and efficiency, is concerned with whether the product or service leads to the result desired. . . . Evaluation thus embraces appraisal of the end result as well as the functioning of the component parts."[72] Thus, in this study, teachers were involved in appraising the units and their effectiveness in enhancing student understanding--the desired end result. Teachers are without question, a major component of the teaching-learning process. Evaluation ". . .in education signifies describing something, in terms of selecting attributes, and judging the degree of acceptability or suitability of that which has been described."[73] It is in this sense that teachers of the new technique of instruction in farm business management were engaged. Teachers having experienced the use of the units are in an excellent position to judge the acceptability and suitability of them to other teachers and to the vocational agriculture curriculum.

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[72] Education For A Changing World of Work, op. cit., p. 65.

The primary method of unit appraisal was by the use of the post-test administered to students in pilot and control schools. This method alone would be a fallacy of the study because it does not give a complete description of the ramifications of the instructional innovation. For this reason, teachers who used the principles technique were utilized in arriving at a more precise image of the impact of the profit-maximizing principles approach to farm business management instruction in vocational agriculture.

It has been found by Brickell[74] and others that if an innovation or experimental technique of instruction is to be disseminated for general use in schools, it must prove to be worthwhile and have the endorsement of teachers. Therefore, pilot school teachers were asked to criticize the design, approach, content and student response to the instructional units in order to appraise their worthiness for further use and development in departments of vocational agriculture. It was felt by the committee that for the units to be accepted by other teachers they should have diversity and be compatible with the vocational agriculture curriculum. The units must also be easy to use and have recognized advantages in improving farm management instruction. It is in this setting that the writer worked with teachers in evaluating the developed instructional units of profit-maximizing principles.

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[73] Chester W. Harris (ed.). Encyclopedia of Educational Research. (New York: The Macmillan Company, 1960), p. 5.

[74] Brickell, op. cit.

Teacher appraisal of the units was secured by the use of four methods: These methods were by (1) the writer visiting each pilot school to (a) observe the use of and student response to the units, and (b) obtain teacher impressions of the units, (2) the use of a unit evaluative survey instrument, (3) by an evaluation meeting with all pilot teachers, and (4) teacher reports to the writer each week on the "Daily Schedule of Activities" sheets.

Visits To Pilot Schools

The writer visited all pilot schools during the course of the study. The purpose of these visits was to observe the use of and student response to the units, and to obtain teacher impressions of them. Furthermore, the writer attempted to assist teachers in the desired use of the materials and to answer questions regarding the project. The first visit was made at some point during which the teacher was using the units. The second visit was at the termination of profit-maximizing principles instruction when the post-test was administered. Both visits proved to be equally helpful in evaluating the units.[75] All teachers were notified in writing as to the dates of both visits. They were instructed as to the purpose of these visits and the expectations of this researcher. Sample copies of these letters are found in Appendix D.

Evaluation visits to the pilot schools are reported here in two parts. First is an account of teacher comments to questions asked in reference to the profit-maximizing principle instructional units. Secondly is a listing of classroom observations made by this researcher as he observed the teacher using the units.

Teacher Comments

Similar basic questions were asked by the writer at all pilot schools. The objective of these questions in evaluating the units with teachers was to determine the user's impressions of the units and his experiences with them. Teachers were asked to be critical. Answers from the teachers were somewhat varied. A sample of typical questions asked and a morsel of comments from teachers are as follows.

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[75] A matrix showing the instructional periods and school visits is located in Appendix F of this study.

1. What is your overall impression of the units?

    a. "Students get confused with the discovery approach."

    b. "It is taking more time than I thought it would."

    c. "It doesn't seem as dry as farm management has been in the past."

    d. "Now that I have taught the units and become familiar with the principles, I will use them with other subject matter in the future."

2. How are you using the units with your class?

    a. "I'm using the material primarily as a guide to my instruction and adopting it to the local situations."

    b. "I'm following the units very closely in teaching the principles."

    c. "I use the materials by incorporating them with crop production."

    d. "I have skipped some examples."

3. What specific difficulties are you having in using the units?

    a. "We are having no difficulties; it's going good."

    b. "I get confused with the concept of average returns."

    c. "Time. The last three units were pushed together in order to stay on schedule."

    d. "The material requires some study before using in class."

4. How do students respond to the material?

    a. "Lower I.Q. boys catch on fairly well--very well when you consider their ability."

    b. "It would be hard to teach without farm boys. Examples would have to be changed for non-farm boys."

c. "I believe the units to be junior and senior level material. Students need a background knowledge of technical agriculture and experience in making farm business decisions."

d. "I believe this is something that the students will retain."

e. "Good. This approach gives you something to center your teaching around rather than just facts."

5. In what ways do you need help from us?

a. "We need guidelines to follow; that is, time we should use to cover principles, teaching order, etc."

b. "I need help in knowing how to integrate the units with other subject matter."

c. "It has been the hardest thing I've ever taught. I lack the technical understanding of the subject matter."

Generally the responses given to questions asked by the writer when visiting the schools were favorable toward the instructional units. In some cases teachers and students were confused with the discovery approach to learning. Many teachers indicated that they lacked a sound understanding of economic principles, while others admitted that the extra study on their part resulted in improved teaching and learning. Users of the developed units tended to be of the opinion that the technique was a move in the right direction; one in which if time was taken to teach the principles approach well, students would benefit a great deal by learning to make sound management decisions based on the profit-maximizing principles.

Classroom Observations

Classroom observations of teacher use of the instructional units and student response to them was enlightening. The list of statements below is a representative sample of observations made by the writer as he visited pilot schools. These statements are divided into four categories; namely, (1) student response, (2) teaching, (3) use of units, and (4) problem areas.

1. Student response:
   a. While some students were interested in the subject matter, others paid little attention.
   b. Students all seemed to be interested in the subject matter and participated in discussion by asking pertinent questions.
   c. Although reluctant to participate in discussion, the students seemed to know and understand what was being taught.
2. Teaching:
   a. A real good job was done in using the materials to make the students think.
   b. Teacher used the materials in guiding and involving the students in reviewing the situation at hand.
   c. References were often made to the school farm and to FFA production projects.
3. Use of units:
   a. There was too much pure duplication and handing out of unit pages with little thought to student benefits.
   b. Teachers did not always use examples as intended; e.g., the discovery approach to teaching the commonalities and understandings of specific principles.

c. The vocational approach was questioned because the teacher became very academic in his teaching technique.

4. Problem areas:

a. The teacher did not understand the inductive process and the discovery approach to teaching.

b. The lack of economic understanding was apparent.

c. This teacher did not make use of related references and local situations.

Class observations confirmed many of the comments previously made by pilot teachers when they discussed the project with the writer. The writer found some teachers failing to motivate their students and thus not making the best use of the instructional units. Other teachers motivated their students with a skillful use of local examples and situations. These individuals used the local setting while following the basic outline of the units in a very desirable manner. Nevertheless, there still remained the general lack of understanding of the discovery approach and of economics. Teachers had the tendency to be insecure because of these deficiencies and the lack of a ready supply of "busy work" for their students. Many teachers found themselves exerting considerably more energy when using the units than when teaching other classroom subject matter. It appeared, however, to this observer that learning was stimulated as a result of this extra effort.

Unit Evaluative Survey Instrument

The second method of evaluation by teachers of the instructional units of profit-maximizing principles was through the use of a survey instrument. The purpose of the instrument was to obtain further teacher impressions of the units. The survey was to serve two functions in carrying out this purpose. First, to encourage teachers to put in writing their feelings and experiences with the units and secondly to stimulate their thinking in critically reviewing the units in preparation for the evaluation meeting which followed at a later date. A copy of the survey instrument and its cover letter are found in Appendix G.

The unit evaluation instrument was mailed to all pilot schools on January 26, 1967, with a cover letter which also announced the evaluation meeting. At this point in time only nine of sixteen pilot schools had completed instruction and post-testing. This researcher and his committee agreed that the group evaluation meeting and the survey instrument would be most beneficial at this time. Reasons for the early date were primarily because teachers who had just finished or who were in the process of using the units would have a more vivid impression in mind and would thus be able to more effectively and constructively criticize the units.

Participating teachers were asked to complete the unit evaluation survey instrument and send it to this researcher by return mail. Thirteen pilot teachers cooperated in this request.

The writer used the responses from these teachers in compiling and summarizing the results of the instrument into a few typical statements.

The evaluation instrument contained ten questions. The first three asked teachers to give yes or no answers. The remainder of the questions were purposely stated to force the participating teacher to criticize the units in depth. The bulk of these questions were very similar in nature. This structure tended to exhaust teacher impressions of the units and thus forced them to give analogous answers. For this reason the writer grouped responses from homogeneous questions into the areas of (1) teacher-centered problems, (2) student-centered problems, (3) unit-centered problems, (4) unit-centered weaknesses, (5) unit-centered strengths, and (6) additions needed. A complete summary of teacher impressions of the instructional units on profit-maximizing principles classified in this manner is found in Appendix G of this study.

The responses to the first three questions showed a positive impression. Twelve of the thirteen teachers stated that the units should be used in vocational agriculture. When asked if they would be interested in participating in the project another year, seven replied yes, two indicated within two years when they taught farm management again, and three were questionable. Teachers were more liberal when asked if they would use the instructional units another year if not involved in a research testing program but supplied with the materials. All answered yes. In stating how they would use the units, most teachers indicated that they would integrate them with other subject matter and material such as marketing, crops and soils management, or related farm management subject matter. Others would simply use the units as reference material.

Responses to the remaining seven questions showed a great amount of indecision. While some teachers perceived a weakness with one aspect of the units, others felt the given point to be a strength. Since teachers were encouraged to be critical, the bulk of the responses were such. Generally, the teachers felt the units were too time consuming to teach and thus should be condensed. They indicated that too much time was required by the teacher to prepare for his lesson while little active student involvement was encouraged throughout the units. Teachers suggested the inclusion of more student problems, worksheets, and activities to relieve this weakness. Several teachers had the problem of not thoroughly understanding the concepts within the principles, thus experiencing difficulty in relating the principle to student interest and practical use. Some teachers felt that at times they failed in using the discovery approach in relating the material to their students. Several teachers stated that the units contained too many examples and too much repetition. Other teachers felt this same way at first but after teaching from all the units the value of the examples in relating commonalities of situations and the discovery of economic principles became apparent. Teachers were in agreement that the units should be bound by a loose leaf binder with charts and tables on separate pages to facilitate duplication for classroom use. Strengths in the developed instructional units also appeared. Teachers generally were of the opinion that the units were well constructed and written with logical sequence and organization. Some teachers stated that when the units were properly used, they would hold student interest, make him think, and bring about the understanding of basic economic principles.

Evaluation Meeting

The third major means of teacher appraisal of the instructional units was by an evaluation meeting. The purpose of this meeting was to review together and obtain interchange among teachers, supervisors and teacher trainers while critically evaluating the units. It was also the desire of this researcher to obtain opinions from the group in attendance for the revision of the units so that they might be further improved and disseminated for greater use within the state. The evaluation meeting offered the opportunity for those involved to obtain the reaction of others and to discover unit strengths and weaknesses that did not appear in previous evaluation methods.

The three-hour evaluation meeting was held at The Ohio State University on February 18, 1967, with this writer in charge. Thirteen of the sixteen pilot school teachers were present. At this point in time all but five of the pilot schools had been post-tested. Pilot teachers having recently completed or about to complete the use of the units offered an excellent setting for appraising the entire project. The meeting agenda included an overview of the project, its status, and its relationship to the vocational agriculture program. This action was followed by a general discussion lead by the writer and his advisors. During this discussion the summary of the previously mentioned survey instrument was shared with the teachers for their reactions. Several teachers were interested to find that some teachers agreed with them while others strongly disagreed with their impressions of the units. Lead questions were presented by the staff for teacher reaction; such as, How did you make it vocational?, Are the difficulties with the units of a methodological or technological nature?, How did you use the material?, and How do we get teachers to use the units? These lead questions stimulated the teachers to respond and actively evaluate with the staff the merits of the units. Once the teachers had been motivated by this technique, they were divided into small committees to critically appraise each of the seven units page by page in order to arrive at specific recommendations for change, additions, and/or deletions. This activity continued for one hour followed by committee reports to the total group. Reports were critiqued by those in attendance and recorded for further use in unit revision.

The following are a few of the suggestions and comments presented by the teachers at the evaluation meeting. Minor recommendations as well as duplications from previous discussed evaluation methods are held at a minimum with a concentration on major items. Recommendations listed here are not limited to individual units but applicable to all.

1. New terms and definitions should be introduced at the beginning of each unit rather than at the rear of the manual of units. They should be simple, outlined, and explained in detail for greater clarification.
2. Combine the units of diminishing physical and diminishing economic returns.
3. It is very difficult to integrate the units with other subject matter the first time they are taught.
4. Some tables and/or charts should be combined to show greater relationship among examples.
5. Prices and yields should be flexible in order to facilitate adaption of units to local situations.
6. Substitution ratios are difficult to understand and therefore should be further explained or deleted.
7. There should be closer relationship and alignment with student project record books. This association should be explained and demonstrated for the teachers.
8. Interest costs, credit, and return on investments should be dealt with in greater detail.
9. A workshop should be held to acquaint all teachers

with the discovery method and the study of economic principles as applied to vocational agriculture.

10. The technique of teaching the units in a block of time is probably the easiest and most effective method the first time it is used. However, after the original experience, the principles may be best taught by integrating them with other compatible subject matter.

Daily Schedule of Activities Sheets

The "Daily Schedule of Activities" sheets completed by pilot teachers served as a fourth means of unit evaluation. Several helpful comments were offered by teachers when reporting to the writer on these forms. Generally, these comments were specific points dealing with the unit or subject matter that the teacher was teaching at the time of his report.

Each teacher was asked to supply the writer with a copy of the schedule of activities each week in order to keep him informed as to the teacher's progress in using the developed units. This sheet also offered the opportunity for teachers to communicate with the writer in reference to specific questions, problems, suggestions, or other related items while still fresh in his mind. The following statements were condensed from comments written on the activity sheets. They have been screened to some extent to avoid duplication of previous evaluative statements by teachers. The statements are grouped into the categories of (1) problems, (2) teacher impressions, (3) suggestions, and (4) student response.

1. Problems

   a. "I had a tendency to lose the students."

   b. "Students are confused as to the practicality of studying this, feeling that it is like math class over again. The purpose of principles is unclear."

   c. "Students seem not to grasp it readily."

   d. "It is difficult to apply the material to practical situations."

   e. "My only difficulty is trying to get students to pick out the conclusions after each example."

   f. "My students have a background that leaves something to be desired, so I must really go slow."

2. Teacher Impressions

   a. "Excellent material--adaptable to farm situation."

   b. "I feel that the boys at this time are very tired of the situations."

   c. "Perhaps these principles are a little above the average high school student's power of comprehension."

   d. "This is a good unit, something that students can understand easily."

3. Suggestions

   a. "A case farm situation can be very useful with these principles."

   b. "Material from Farm Business Planning and Analysis can be used with this topic."

   c. "Lead questions seem to be a good interest technique."

   d. "Prepared quizes should be included with each unit."

4. Student Response

   a. "The students picked up this very quickly and are enjoying this kind of learning."

b. "Student response is real good; their appetites are whetted with considerable discussion!"

c. "Interest is really stimulated."

d. "Boys are becoming bored with it. Too much at one time."

This method of evaluating the units on profit-maximizing principles showed similar teacher responses to those found in the previous three methods. A great deal of indecision, contradiction, and poor understanding continued to be evident. The writer attributes this teacher reaction to the lack of experience with the instructional units, economic principles, and the discovery approach to learning. Several teachers commented that a more complete and efficient teaching-learning experience would take place if the materials were used another year. Lovenstein and his associates had a similar experience with teachers using their newly developed teaching materials. In reporting their research with the development of economic curricular materials, they stated,

> . . .teachers operated under handicaps such as limited understanding of economics and of this course in particular. . . . The first-semester students had a tendency to state the concepts in a rote manner and explained them vaguely or not at all, whereas the second-semester students related and explained the concepts more fluently using economic terms. . . . Students had a clearer grasp of ideas and more ability to work with them as to recognize and assimilate facts. It may be inferred that a semester of experience did make an important difference in the results this teacher got.[76]

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[76] Lovenstein, op. cit., pp. 482-484.

Summary

This chapter has dealt exclusively with teacher evaluation of the instructional units of profit-maximizing principles. Teachers' appraisal of the units was believed to be imperative in the design of this study; for without teacher guidance and influence as users of the material, it would be difficult to improve upon the original work and to measure merits of such an endeavor. Their involvement was an asset in proving the worth of the economic principles approach to the researcher and to other teachers.

Teacher evaluation of the units was secured through four methods; namely (1) by the writer visiting the local pilot schools, (2) the use of an evaluative survey instrument, (3) an evaluation meeting, and (4) weekly reporting sheets from teachers.

Results from these evaluation methods proved to be similar. Generally, pilot teachers were strongly in favor of the units, feeling that the profit-maximizing principles approach to farm management was a move in the direction of improving this vital phase of the vocational agriculture curriculum. They found the new technique to teaching a challenging and time-consuming task. It required extra study and effort on the teacher's part, but once he had set forth the extra preparation and teaching time and effort, students seemed to respond with renewed interest. There remained throughout the study some confusion, indecision, and disagreement among teachers as to their impressions of the units. Teachers agreed that the units should be used in vocational agriculture and that they would personally use the material again. Many enlightening suggestions, comments, problems, and uses appeared through the unit evaluation by teachers. Appraisal clearly brought forth the need for teacher in-service training for using the principles approach to vocational learning as well as further familiarization with economic principles.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The major purpose of this study was to measure the relative effectiveness of instructional units designed to enhance student understanding of profit-maximizing principles when used in classes of vocational agriculture.

Need for the Study

Accelerated changes taking place in American agriculture have forced agricultural educators to adjust the vocational agriculture curriculum to meet the educational needs of students bound for the technical and scientific world of agriculture. In the adjustment, a pressing need becomes apparent for effectively teaching farm business management to high school students. As a means of fulfilling this need, a series of instructional units was developed which was centered on the understanding of seven profit-maximizing principles. Basic principles were concentrated upon, since they lend themselves to student knowledge and application of the "whys" in agricultural business decision-making.

Once an educational innovation has been designed it must be tried and evaluated. It was for this reason that the study, "An Appraisal of Instructional Units to Enhance Student Understanding of Profit-Maximizing Principles," was conducted with the cooperation of 22 Ohio vocational agriculture departments. The study was to evaluate unit effectiveness and appropriateness to the vocational agriculture curriculum in strengthening farm management instruction.

Specific Objectives

The following specific objectives were developed to facilitate the pursuit of this study:

1. To determine what technique of instruction results in the greatest level of student understanding of profit-maximizing principles.
2. To determine the relationship between student understanding of profit-maximizing principles and the following independent variables:
    a. Student year in vocational agriculture
    b. Student year in high school
    c. Student years of farm experience
    d. Student I.Q.
    e. Economics courses taken by student in high school
    f. Number of teachers in vocational agriculture department
    g. College quarter hours of economics instruction received by the teacher
    h. Teacher having received Farm Business Planning and Analysis instruction
    i. Teacher having coordinated a Farm Business Planning

    and Analysis program

   j. Teacher's years of teaching experience
   k. Teacher's attainment of an advanced degree
   l. Hours of instructional time used
   m. Local grades (achieved by student).

3. To determine the effects of the independent variables upon student understanding of each profit-maximizing principle.
4. To conduct teacher evaluation of the developed instructional units of profit-maximizing principles.

Procedures Employed in the Study

The procedures employed in this study were designed to measure the relative effectiveness of newly prepared instructional units. The units were developed by the Department of Agricultural Education, The Ohio State University, under the direction of Ralph E. Bender, department chairman; staff member, Floyd G. McCormick; and this writer. The purpose of the units was to enhance student understanding of basic profit-maximizing principles as applied to farm business management when used by high school teachers in classes of vocational agriculture. Uniqueness existed in the instructional units in that they were designed to be taught by the inductive process of teaching with the discovery approach to learning. This technique concentrated on student understanding of basic economic principles and not on the rote memory of farm management facts. After the instructional units had been designed and developed, the task of systematically using and evaluating the new technique began. Twenty-two high schools offering vocational agriculture to juniors and/or seniors in Ohio were selected to perform the trial function and to assist in evaluating the worth of the instructional units.

The major steps used in this study were: (1) selecting pilot and control schools, (2) orienting teachers with the project, (3) field supervision of participating schools, (4) selecting and administering an evaluative post-test, (5) obtaining teachers' evaluation of the units, and (6) summary and analysis of data.

Careful selection was made of pilot and control schools used to appraise the effectiveness of the developed instructional units. Of 86 Ohio vocational agriculture teachers who indicated an interest in participating in the profit-maximizing principles research project, 22 were selected and randomly assigned to a control or pilot group to complete the instructional unit evaluation. Two hundred sixty-two junior and senior students enrolled in vocational agriculture at these schools completed the post-test. Six of the twenty-two schools acted as controls and taught farm management in the traditional manner. The remaining sixteen institutions were asked to act as pilot schools in using the developed instructional units and to teach them with the inductive process and the discovery approach to learning. Seven of the sixteen schools were assigned as pilot-block to teach from the units in an uninterrupted sequence of approximately six weeks while the remaining nine schools were designated as pilot-integrated to use the same materials by integrating them with other subject matter during the trial period.

In an attempt to keep the twenty-two participating teachers well-informed of the purpose and status of the study, every effort was extended to continually communicate with them. Once the schools had been selected by mid-July, 1966, the teachers of vocational agriculture were immediately notified by letter. They were asked to obtain specific reference materials and informed of an August 29, 1966 seminar session to further acquaint them with the project. This initial orientation meeting was followed by two local area seminars with pilot teachers designed to specifically acquaint them with the instructional units and the suggested techniques of using them. Individual conferences were later held with all participating teachers throughout the trial period. State supervisors, teacher trainers, school administrative staff, and other persons related to the study were continually informed of the project's status.

A carefully planned and structured program was organized to coordinate the efforts of all participating teachers while they were involved in the study between October 17, 1966, and March 17, 1967. The writer visited each control and pilot school twice during this trial period. The first visit was to observe, the second to administer the post-test to participating students. Evaluation of the instructional units took place continually throughout the trial and testing period. Teachers were asked for their impressions, problems, student response, use, questions, suggestions, and other comments applicable to unit improvement. All teachers kept this writer informed of their progress through the use of a weekly reporting form. This form was also helpful in evaluating the instructional units.

Student understanding of profit-maximizing principles was measured through the use of an evaluative post-test developed by McCormick.[77] The instrument consisted of 45 multiple-choice questions. It was administered by this researcher at all schools within two weeks after farm management instruction had been completed.

The post-test was the primary method of instructional unit evaluation. However, this means alone did not give a complete description of the ramifications of the instructional innovation. For this reason, pilot teachers who used the principles technique were utilized in obtaining a more precise image of the impact of the units. Teacher subjective appraisal of the units was secured by (1) the writer visiting each pilot school to (a) observe the use of and student response to the units and (b) obtain teacher impressions of the instructional units, (2) the use of a unit evaluative survey instrument, (3) an evaluation meeting with all pilot teachers, and (4) by the previously mentioned weekly reporting forms.

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[77] McCormick, op. cit.

Once all objective data had been secured and compiled, it was taken to the Statistical Laboratory of The Ohio State University. There it was punched into electronic data processing cards and analyzed by the IBM 7094 computer. The F test of analysis of variance followed by the Duncans multiple-range statistic was used to determine the significance of difference among the mean post-test scores achieved by students comprising the three participating groups. Independent variables were grouped by level of measurement and subjected to the Pearson product-moment correlation r, the t and/or the F test to determine their influence upon student understanding of profit-maximizing principles pertaining to all instructional units combined and to each specific principle.

Major Findings

Major findings derived from the analysis of data collected through this study are listed below. They are grouped according to the major emphasis used in the pursuit of instructional unit evaluation.

Technique of Instruction Resulting in the Greatest Level of Student Understanding of Profit-Maximizing Principles

The pilot-block group of students involved in this study obtained the highest score on the post-test which measured the understanding of profit-maximizing principles. This group was followed in sequence by the pilot-integrated and control groups.

From Table 46 it can be noted that respective scores were 61.3, 58.4, and 54.0, with an average of 58.0 for all schools combined.

TABLE 46

COMPARISON OF MEAN POST-TEST SCORES IN TOTAL AND FOR EACH INSTRUCTIONAL UNIT

	Percentage of Correct Responses Selected			
Profit-Maximizing Principle	Control (n=77)	Pilot-Block (n=77)	Pilot-Integrated (n=108)	All Schools (n=262)
All units combined	54.0	61.3	58.4	58.0
Unit 1 (Diminishing Physical Returns)	58.4	68.4	65.1	64.1
Unit 2 (Diminishing Economic Returns)	50.0	62.3	57.1	56.6
Unit 3 (Fixed-Variable Costs)	54.0	61.6	56.6	57.3
Unit 4 (Substitution)	52.7	64.7	60.7	59.5
Unit 5 (Opportunity Costs)	43.0	51.6	52.0	49.2
Unit 6 (Combination of Enterprises)	53.3	57.2	55.7	55.4
Unit 7 (Time Relationships)	68.4	64.7	63.3	65.2

Statistically this difference in total post-test scores is significant above the .05 level of confidence indicating that the instructional units taught by the pilot-block technique were superior to either the pilot-integrated or the traditional techniques. It further indicates that the pilot-integrated technique enhanced student understanding of profit-maximizing principles to a greater extent than did the traditional technique.

Test scores received by students concerning each of the profit-maximizing principles as shown in Table 46 reveal a similar outcome as did the total test score concerning all seven units. The pilot-block group excelled the other two groups on units 1, 2, 3, 4, and 6. Control and pilot-integrated groups obtained the highest scores on one unit each. These were units 7 and 5, respectively. The control group achieved the lowest score on five units while the pilot-integrated obtained second rating on the same quantity.

Because of the results obtained in this study, the null hypothesis was rejected which stated that there would be no significant difference among the pilot and control schools relative to level of understanding of profit-maximizing principles.

Relationship Between Student Understanding of Profit-Maximizing Principles and the Independent Variables

Of the thirteen independent variables, four proved not to be significantly related to student post-test scores.

These independent variables were:

1. Student year in high school.
2. Economic courses taken by students in high school.
3. Teachers having received Farm Business Planning and Analysis instruction.
4. Teachers having coordinated a Farm Business Planning and Analysis program.

Three independent variables showed a very minor degree of relationship with post-test scores. In each case only one group of students of the three within the study proved to be significant at the .05 level of confidence. These factors would tend not to be reliable in predicting post-test scores. The independent variables in this classification were:

1. College quarter hours of economics instruction received by the teachers.
2. Hours of instructional time used.
3. Local grades.

The six remaining independent variables tended to be more closely associated with total post-test scores achieved by participating students. However, these factors present only a low degree of relationship. They were:

1. Student year in vocational agriculture.
2. Student years of farm experience.
3. Student I.Q.
4. Number of teachers in the vocational agriculture department.

5. Teacher's years of teaching experience.
6. Teacher's attainment of an advanced degree.

The first four items had a positive relationship with student understanding of profit-maximizing principles. The latter two were found to have an inverse relationship with student understanding.

The null hypothesis was rejected due to the findings of this study. It stated that there would be no relationship between the independent variables and student understanding of profit-maximizing principles.

The Effects of Independent Variables Upon Student Understanding of Each Profit-Maximizing Principle

Analysis of the effects of the independent variables upon student understanding of individual profit-maximizing principles revealed similar results as were found when total post-test scores were compared with each independent variable.

Of the thirteen independent variables, six proved to be statistically non-significant in association with student test scores on individual instructional units. The six were:

1. Student year in high school.
2. Economics courses taken by students in high school.
3. College quarter hours of economics instruction received by the teacher.
4. Teachers having received Farm Business Planning and Analysis instruction.

5. Teachers having coordinated a Farm Business Planning and Analysis program.
6. Hours of instructional time used.

Two independent variables showed very minor negative relationship. In both cases significant values were only sporadic. These two factors were:

1. Teacher's years of teaching experience.
2. Teacher's attainment of an advanced degree.

The remaining five independent variables displayed a greater degree of association with test scores concerning specific instructional units. It is noted, however, that influence from these factors was relatively low. They were:

1. Student year in vocational agriculture.
2. Student years of farm experience.
3. Student I.Q.
4. Number of teachers in vocational agriculture department.
5. Local grades.

It was hypothesized that there would be no effects of the independent variables upon student understanding of each profit-maximizing principle. Since some association was found between the two factors, the null hypothesis was rejected.

Composite Association of Independent Variables with Student Understanding of Profit-Maximizing Principles

Results obtained in achieving objectives two and three of the study demonstrated the association of thirteen independent variables with student understanding of profit-maximizing principles. Objective two was concerned with total post-test scores covering all instructional units whereas objective three dealt with test scores achieved on specific questions pertaining only to individual instructional units. Table 47 depicts the degrees of association of the independent variables with student understanding of profit-maximizing principles.

TABLE 47

DEGREES OF ASSOCIATION OF INDEPENDENT VARIABLES WITH STUDENT UNDERSTANDING OF PROFIT-MAXIMIZING PRINCIPLES

	None		Minor		Some	
Independent Variable	All Units	Individual Units	All Units	Individual Units	All Units	Individual Units
1. Student year in vocational agriculture					x	x
2. Student year in high school	x	x				
3. Student years of farm experience					x	x
4. Student I.Q.					x	x

TABLE 47--Continued

	None		Minor		Some	
Independent Variable	All Units	Individual Units	All Units	Individual Units	All Units	Individual Units
5. Economics courses taken by students in high school	x	x				
6. Number of teachers in Vo-Ag department					x	x
7. College quarter hours of economics instruction received by the teacher		x	x			
8. Teacher having received Farm Business Planning and Analysis instruction	x	x				
9. Teacher having coordinated a Farm Business Planning and Analysis Program	x	x				
10. Teacher's years of teaching experience					x	x[a]
11. Teacher's attainment of an advanced degree					x	x[a]
12. Hours of instructional time used		x	x			
13. Local grades			x			x

[a] Demonstrated a negative influence.

Degrees of association are categorized by (a) none, (b) minor, and (c) some. Only in a few instances were independent variables considered to have more than a slight relationship with student understanding. For this reason there was no need to include a category for more than "some" association. It is noted that four independent variables (2, 5, 8, and 9) had no association with student understanding of profit-maximizing principles with all units combined or when individual units were analyzed separately. Likewise, four independent variables (1, 3, 4, and 6) having some degree of relationship, were consistent throughout both analyses. However, there were five independent variables (7, 10, 11, 12, and 13) that showed inconsistent minor association with student understanding. While some shifted to no association upon close examination of the relationship with individual unit test scores, others tended to be more significant. Differences in numbers of students dealt with and the inconsistency among teachers and schools appeared to cause this relationship.

Teacher Evaluation of Instructional Units

Teacher evaluation of the instructional units was found to be helpful in appraising the worth of the units and the discovery approach of the inductive process to learning profit-maximizing principles.

Results from the four evaluation methods proved to be similar. Generally, pilot teachers were strongly in favor of the units; feeling that the profit-maximizing principles approach to farm management was a move in the direction of improving this vital phase of the vocational agriculture curriculum. They found the new technique of teaching a challenging and time-consuming task. It required extra study and effort on the teacher's part, but once he had set forth the extra preparation and teaching time and effort, students seemed to respond with renewed interest. There remained throughout the study some confusion, indecision, and disagreement among teachers as to their impressions of the units. Teachers agreed that the units should be used in vocational agriculture and that they would personally use the material again.

Conclusions

The following conclusions were drawn by the investigator, based on his interpretation of the data and information presented in this study.

1. The developed instructional units enhanced student understanding of profit-maximizing principles to a greater degree than did the traditional technique of teaching farm management used by control schools.
2. When teachers of vocational agriculture used the developed units in an uninterrupted block of instructional time, students showed a greater understanding of profit-maximizing principles than did students whose teachers used the pilot-integrated technique of teaching farm management from the units.

3. Student understanding of profit-maximizing principles was slightly influenced positively by the association of four independent variables as investigated through this study. They were:
    a. Student year in vocational agriculture.
    b. Student years of farm experience.
    c. Student I.Q.
    d. Number of teachers in the vocational agriculture department.
4. Teachers who appeared to have the greatest appreciation of profit-maximizing principles, the developed instructional units, and the discovery method of teaching, tended to more effectively employ the new technique of farm management instruction in classes of vocational agriculture.
5. Teachers who used the instructional units believed that the profit-maximizing principles approach to farm management instruction in vocational agriculture greatly strengthened this vital phase of the vocational agriculture curriculum.
6. Pilot teachers found the instructional units challenging, time-consuming, and requiring extra study, yet this extra preparation and teaching efforts tended to result in greater student interest and achievement.

Recommendations

As a result of the findings of this study and the experiences of the writer, the following recommendations are made:

1. That the profit-maximizing principles approach be continued and extended into greater numbers of vocational agriculture departments.
2. That in-service education programs be offered to teachers of vocational agriculture to further acquaint them with the profit-maximizing principles, the instructional units, and the discovery method of teaching.
3. That state vocational agriculture staffs provide assistance to teachers in planning and organizing local farm management instruction to effectively include the instructional units.
4. That prospective teachers of vocational agriculture be given experience in using the profit-maximizing principles and the instructional units during undergraduate study and student teaching.
5. That greater emphasis be placed on the use of the discovery method and the inductive process in teaching and learning the profit-maximizing principles when using the instructional units in local vocational agriculture departments.
6. That a continuous effort be made by teachers to assure

a vocational education approach when using the instructional units by relating them to the students' agricultural interests.

7. That further attention be given to the development of instructional units concerning basic principles in other areas of the vocational agriculture curriculum.

Recommendations for Further Study

In the pursuit of this study, the writer became aware of the need for continued research. He suggests that:

1. The instructional units be revised to include recommendations of teacher trainers, state supervisors, and teachers who used the materials and according to the findings of this study.
2. This study be repeated using a larger sample selected at random throughout the State of Ohio.
3. The revised instructional units be used by teachers of vocational agriculture in several states to determine their appropriateness in strengthening farm management instruction in various regions of the country.
4. A follow-up study be made of students who receive farm management instruction by the principles technique to determine the application made of the profit-maximizing principles.
5. Study be made of vocational agriculture teachers to determine the technical and professional training

needed to effectively teach the understanding of profit-maximizing principles by the discovery method.

6. Replication of this study be made using teachers who have experienced the use of the instructional units and an equal number of teachers who have not, to determine the values of familiarity with the profit-maximizing principles, the instructional units, and the discovery method of teaching.

APPENDIX A

LIST OF THE SEVEN PROFIT-MAXIMIZING PRINCIPLES

PROFIT-MAXIMIZING PRINCIPLES

I. DIMINISHING PHYSICAL RETURNS:

The application of additional units of variable resources to a unit of fixed resource increases total output but, after a certain point, the amount added to total output by each successive unit of variable resource diminishes.

II. DIMINISHING ECONOMIC RETURNS:

After a certain point, the economic returns for each successive unit of variable resource added to a unit of fixed resource tends to decline. However, the farm manager, in order to secure maximum profits, should continue adding variable resources to fixed resources as long as marginal returns are greater than marginal costs.

III. FIXED-VARIABLE COSTS:

The cost per unit of production can be decreased by spreading fixed costs over more units of production. Therefore, the farm manager should continue using more resources, if capital is available, to increase production as long as variable costs are covered by the marginal returns.

IV. SUBSTITUTION:

When two or more types of resource inputs can be used to produce a given amount of output, the value of the resource replaced or displaced by another resource should be greater than the value of the resource added if the farm manager is to secure maximum profits.

V. OPPORTUNITY COSTS:

The profit of a farm business will be greatest if each unit of land, labor, and capital is used where it will add the greatest marginal returns to the farm business; thus, the farm manager cannot change the distribution of a single unit of variable resource input without reducing farm income.

VI. COMBINATION OF ENTERPRISES:

The best combination of enterprises is where a farm business is so organized that the farm manager cannot add to or expand the size of one enterprise or delete or contract another enterprise without reducing income of the farm business.

VII. TIME RELATIONSHIPS (TIME COMPARISON):

Before investing limited capital resources in the farm business, the farm manager should determine the present value of future income in order to make comparisons between alternatives over time; that is, determine the economic feasibility of making capital investments in the present to obtain income in the future.

APPENDIX B

FORMAT FOR DEVELOPING INSTRUCTIONAL UNITS

FORMAT FOR DEVELOPING INSTRUCTIONAL UNITS

I. Profit-Maximizing Principle Unit Title

II. Unit Objectives

III. Introduction

   a. Techniques for introducing units.

IV. Teaching - Learning Activities (Educational Experiences)

   a. Based upon presentation of real examples.

   b. Technical information incorporated in this section.

V. Association of Above Examples

   a. Objective of this section - arrive at generalizations.

VI. Arriving at Principle based upon above generalizations

VII. Activities for students to use in applying understanding of identified principle

APPENDIX C

INDIVIDUALS AND SCHOOLS CONNECTED WITH THE STUDY

PERSONS ASSISTING WITH THE DEVELOPMENT OF INSTRUCTIONAL UNITS AND COMPLETION OF STUDY

Advisory Committee

1. Dr. Ralph E. Bender, Chairman, Department of Agricultural Education, The Ohio State University.
2. Dr. Richard H. Baker, Farm Management Specialist of the Agricultural Economics Department, The Ohio State University.
3. Dr. James W. Hensel, Program Specialist in Agricultural Education, The Center for Vocational and Technical Education, The Ohio State University.
4. Dr. William B. Logan, Professor of Education and Director of Distributive Education, School of Education, The Ohio State University.
5. Dr. Robert E. Taylor, Director of The Center for Vocational and Technical Education, The Ohio State University.

Administration

1. Dr. Ralph E. Bender, Chairman, Department of Agricultural Education, The Ohio State University. Administrator of the project and major adviser to the writer.
2. Dr. Floyd G. McCormick, Farm Business Planning and Analysis specialist, Department of Agricultural Education, The Ohio State University.
3. Dr. Harlan E. Ridenour, Director of The Ohio Vocational Agricultural Instructional Materials Service.

Technical Assistants

1. Richard Adams, Teacher of agriculture, Northwestern High School, Springfield, Ohio.
2. Homer Brown, Teacher of agriculture, Garaway High School, Sugarcreek, Ohio.
3. Homer Burt, Teacher of agriculture, Wauseon High School, Wauseon, Ohio.
4. Carl Nagy, Teacher of agriculture, Hillsdale High School, Jeromesville, Ohio.
5. Benjamin White, Teacher of agriculture, Manchester High School, Manchester, Ohio.

Supporting Consultants

1. Dr. Virgil E. Christensen, Research Design Consultant, The Center for Vocational and Technical Education, The Ohio State University.
2. John A. Rolloff, Assistant Supervisor for Agricultural Education of Ohio Research Coordination Unit. (Later replaced by James B. Hamilton.)
3. Dr. Mervin G. Smith, Chairman, Department of Agricultural Economics, The Ohio State University.
4. Warren G. Weiler, Director of the Agricultural Division of Vocational Education, Ohio State Department of Education. (Later replaced by James E. Dougan.)
5. Dr. D. Ransom Whitney, Director of the Statistical Laboratory, Department of Mathematics, The Ohio State University.

Participating Teachers

1. Gilman R. Baker, New London High School
2. Clifford Baughman, Graham High School
3. Robert Brandt, Spencerville High School
4. Lawrence Brockett, South Central High School
5. Donald Broering, St. Henry High School
6. Raymond Griffith, Riverview High School
7. Donald Hahn, Clear Fork Valley High School
8. Donald L. Holt, Jackson Center High School
9. Robert E. Knedler, Fairbanks High School
10. Virgil Koppes, Buckeye High School
11. Jack Nowels, Loudonville High School
12. Bradley G. Patrick, Mississinawa Valley High School
13. Harry Plank, Smithville High School
14. John A. Shank, Shelby Senior High School
15. John S. Sherrick, Crestview High School
16. Andrew B. Stoner, Buckeye High School
17. Jerry E. Vogt, Coldwater High School
18. Brooks D. Ware, Hardin-Houston High School
19. William C. Watt, Lucas High School
20. Wilbur R. Weir, Cloverleaf High School
21. Ralph Welch, Mapleton High School
22. Merrill Williams, Upper Scioto Valley High School

PARTICIPATING SCHOOLS BY GROUP AND NUMBER

Control

1. Clear Fork Valley High School, Bellville, Ohio
2. Coldwater High School, Coldwater, Ohio
3. Fairbanks High School, Milford Center, Ohio
4. Graham High School, St. Paris, Ohio
5. New London High School, New London, Ohio
6. Shelby Senior High School, Shelby, Ohio

Pilot-Block

7. Cloverleaf High School, Lodi, Ohio
8. Jackson Center High School, Jackson Center, Ohio
9. Loudonville High School, Loudonville, Ohio
10. Lucas High School, Lucas, Ohio
11. Mississinawa Valley High School, Union City, Ohio
12. Riverview High School, Warsaw, Ohio
13. Upper Scioto Valley High School, McGuffy, Ohio

Pilot-Integrated

14. Buckeye High School, Rushsylvania, Ohio
15. Buckeye High School, Mallet Creek, Ohio
16. Crestview High School, Olivesburg, Ohio
17. Smithville High School, Smithville, Ohio
18. South Central High School, Greenwich, Ohio
19. Hardin-Houston High School, Houston, Ohio

Pilot-Integrated--Continued

20. Mapleton High School, Nankin, Ohio

21. Spencerville High School, Spencerville, Ohio

22. St. Henry High School, St. Henry, Ohio

APPENDIX D

CORRESPONDENCE

June 3, 1966

TO: Teachers of Vocational Agriculture responsible for teaching vocational agriculture III and/or IV in 1966-67

FROM: Dr. Ralph E. Bender, Chairman, Department of Agricultural Education; Mr. Warren G. Weiler, Head State Supervisor of Vocational Agriculture

SUBJECT: Profit-Maximizing Principles Project

The Department of Agricultural Education is presently involved in a study to develop a method for teaching profit-maximizing principles. This project, under the direction of Dr. Floyd McCormick and Richard Barker, is designed to help improve the quality of agricultural economics instruction (primarily farm management) in high school programs of vocational agriculture. The approach of this study is to develop an application of economic principles that will enable the students to better understand the "why" involved in the decision-making process.

In order to determine the value of this approach, teaching units dealing with economic principles have been developed. However, these units need to be used in a field situation to determine their significance in aiding students to understand the "why" of decision making. This testing needs to be done in Ohio departments of vocational agriculture with junior and/or senior classes.

We need to determine if selected teachers of vocational agriculture would be willing to cooperate with the department in field testing these teaching units during the 1966-67 school year. The units will require approximately six weeks of class time between October 17 and February 17.

Pilot schools will be involved in using the teaching units during the period mentioned above either in an uninterrupted sequence or integrated with other subject matter. Control schools will continue to teach farm management in the present manner. Both pilot and control schools will be involved in pre and post testing.

To: Teachers of Vocational Agriculture responsible for teaching
vocational agriculture III and/or IV in 1966-67

June 3, 1966

Page 2

Your cooperation in this project is needed. Would you kindly fill out the enclosed post card indicating your interest in this project and return to us no later than June 15th?

Final selection of pilot and control schools will be made after receiving your reply to this letter.

July 18, 1966

TO: Teachers of Agriculture responding to inquiry of interest in the Profit-Maximizing Principles Project

FROM: Dr. Floyd G. McCormick and Richard L. Barker

SUBJBCT: Selection of Evaluation Schools

Your interest in the "Profit-Maximizing Principles" Project is very much appreciated! You were one of many teachers who responded to our call for assistance in the field evaluation of these new materials.

Because of the limited budget, time, and personnel allotted to the project, the selection committee is unable to include your school within the evaluation team at this time.

If for some reason it becomes necessary to adjust our present plans to include your school, we will notify you at once. We will be looking forward to your participation in using these materials next year should the evaluation prove them significant and beneficial in the vocational agriculture curriculum.

Thanks again for your professional support in the furthering of vocational agriculture in Ohio through your cooperation in helping us to help you.

July 18, 1966

TO: Teachers of Agriculture interested in the Profit-Maximizing Principles Project

FROM: Dr. Floyd G. McCormick and Richard L. Barker

SUBJECT: Selection of Evaluation Schools

Your interest in the "Profit-Maximizing Principles" project is very much appreciated! You were one of many teachers who enthusiastically responded to our call for assistance in field evaluating the new materials.

Great care has been taken in selecting appropriate schools to carry out the task of evaluating the effectiveness of using these units for high school teaching of economic principles. It was the aim of the selection committee to choose a representative sample of the schools in Ohio and if possible to select an area within the state where a concentration of interest existed. Therefore, we are happy to inform you that your school has been selected as a (pilot center, control center).

Field testing will begin in October. Previous to this, a seminar session will need to be held to acquaint you with the project and to formulate preliminary plans. This meeting is scheduled for August 29, in Room 246, Agricultural Administration Building at 10:00 a.m. Your expenses will be reimbursed. If for any reason you cannot attend or if you do not wish to continue with the project, please notify us at once.

If you are within the pilot group and do not have a copy of the following two books we suggest that you place them on your department's request list for they will be helpful as references in using the instructional units.

1. Castle, Emery N. and Manning H. Becker, Farm Business Management; The Decision-making Process, New York: Macmillan, 1962.

2. Heady, Earl O. and Harold R. Jensen, Farm Management Economics, New York: Prentice-Hall, Inc., 1954.

January 4, 1967

Mr. School Principal
Participating High School
School Location, Ohio 44982

Dear Mr. Principal:

We would like to take this opportunity to thank you for allowing us to work with Mr. Participating Teacher and your vocational agriculture department in the "Profit-Maximizing Principles Research Project." Mr. Participating Teacher's excellent cooperation has been very encouraging to us. We believe the economic principles approach to farm business management will strengthen this vital phase of the vocational agriculture program.

It is through research projects of this type that we are able to help you to advance instruction in your vocational agriculture department. Your professionalism in cooperating with The Ohio State University is appreciated!

May the New Year bring you and your school system the best of success.

Sincerely,

Richard L. Barker
Research Assistant

RLB/rmb

cc Mr. Participating Teacher

SAMPLE COPY

January 17, 1967

Mr. John S. Sherrick
Crestview High School
Route 1
Ashland, Ohio 44805

Dear Mr. Sherrick:

I am pleased with your progress with the Profit-Maximizing Principles instructional units.

We are trying to visit each of the schools sometime during the period while the teacher is using the units. This is in order to aid in whatever way we can and to obtain your impressions of, to observe the use of, and student response to the units.

Therefore, I plan to be at Crestview High School on Wednesday, February 8, 1967; hopefully arriving from Mapleton High School by the time your class begins at 11:38 a.m.

If the above arrangement does not meet with your approval for some reason or if you will not be using the units on that date, please contact me at once and suggest alternative dates.

Sincerely,

Richard L. Barker
Research Assistant

RLB/rmb

SAMPLE COPY

January 6, 1967

Mr. Raymond Griffith
River View High School
Route 1
Warsaw, Ohio 43844

Dear Mr. Griffith:

I plan to be at your school on January 18 to administer the post test to your students involved in the Profit-Maximizing Principles Research Project, as we discussed on December 20, 1966. There will be forty-five multiple choice questions which will require up to fifty-five minutes for your students to complete. Therefore, it is imperative that we proceed with the exam at the very beginning of your class period which commences at 1:52.

If for some reason the above date does not meet with your approval, please contact me at once and suggest alternative dates.

Sincerely,

Richard L. Barker
Research Assistant

RLB/rmb

APPENDIX B

DATA GATHERING INSTRUMENTS

No.______

Name______________________________ School__________________________

MULTIPLE CHOICE QUESTIONS ON FARMING

INSTRUCTIONS

Each problem below includes a statement followed by several possible answers labeled a, b, c, d. Select the answer which best completes the statement and then place a check (X) to the left of the answer in the blank ____ space provided. Answer all questions. Check only one answer per question. Read each question and each possible answer carefully before selecting your choice.

Example

Question: For a farm operator who is heavily in debt, the most important factor to consider in choosing enterprises to combine into a farm business is:

___a. personal preference

___b. labor distribution

_X_c. relative profit per unit of investment as compared with competing enterprises.

___d. capital necessary to begin new enterprises.

QUESTION: (1) A farmer is told that he can obtain an increase in daily gain of feeder pigs by the addition of one-half pound of protein supplement placed in the daily ration. He thinks this is good and, therefore, adds 1# of protein supplement to the daily ration. Which of the following results is most likely to occur?

____a. daily gain per head will be doubled.
____b. daily gain per head will remain the same.
____c. daily gain per head will increase but not double.
____d. daily gain will actually decrease.

QUESTION: (2) A farmer is able to produce 70 bushels of oats per acre with the application of 100# commercial fertilizer per acre. By varying only one factor of production, in this case, the amount of fertilizer applied, he can receive a yield increase of 12 bushels per acre with the application of 200# of additional commercial fertilizer. A 300# increase in fertilizer would result in an additional yield increase of 6 bushels per acre and a 400# increase in an additional yield of 2 bushels per acre. If oats will sell for 80¢ per bushel and the fertilizer costs $4.00 per hundred, how much fertilizer should be applied to maximize his net income?

____a. 100#
____b. 300#
____c. 400#
____d. 500#

QUESTION: (3) Purchasing a larger piece of machinery in order to reduce the cost required to complete a particular operation is feasible if:

____a. the savings in labor is less than the cost of owning the larger machine.
____b. there is sufficient capital available.
____c. the savings in labor is equal to the cost of owning the larger machine.
____d. the value of labor saved is greater than the cost of owning the larger machine.

QUESTION: (4) Up to harvest time a farmer has spent $10 per acre for labor, seed, and machine costs on oats. Price of oats has fallen, and a severe local drought has reduced his yields. With an anticipated price of 70¢ per bushel on an expected yield of 10 bushels per acre, the farmer cannot expect to make a profit on this crop. Assuming that the oats crop can be harvested for $3 per acre, the farmer should:

____a. assume his $10 loss for the year and leave the oats in the field.
____b. harvest the oats crop.
____c. sell the oats crop as pasture for $2 per acre.
____d. sell the oats crop for hay at $3 per acre.

QUESTION: (5) Assuming a farmer with limited capital can get $4 return for each $1 invested in protein supplement for hogs, he should invest his limited funds in a new crop variety if:

____a. net profit on the crop is increased.
____b. investments in new varieties return at least $4 for $1 of added costs.
____c. investments in new varieties return more to net profit than investments in protein for hogs.
____d. investments in new varieties increase yields per acre, crop quality and total farm gross income.

QUESTION: (6) On a large cash grain and hay farm where summer labor is limited, which one of the following enterprises would fit in the best, providing adequate facilities and equipment exist?

____a. sheep
____b. cattle feeding
____c. hog feeding
____d. laying hens

QUESTION: (7) Referring to the table below, which level of fertilizer application would yield the most return to the farmer per $1 invested in fertilizer:

Quantity of Fertilizer Added	Total Yield	Cost of Added Fertilizer	Value of Added Yield
0#	60 bushels	$ -	$ -
10#	65 bushels	1.50	4.50
20#	68 bushels	1.50	2.70
30#	70 bushels	1.50	1.80
40#	71 bushels	1.50	.90

____a. 10#
____b. 20#
____c. 30#
____d. 40#

QUESTION: (8) Assuming that 100# of pork can be produced either with 340# corn and 15# soybean meal or with 270# corn and 40# soybean meal, which item below would be the most important for the farmer to consider before he makes the decision regarding which combination to feed?

____a. the price of soybean meal per pound.
____b. the price of corn per pound.
____c. the price of hogs per hundredweight.
____d. the price of corn and soybean meal per pound.

QUESTION: (9) Referring to fixed costs such as insurance and taxes and variable costs such as seed, feed, and fertilizer as they relate to the farm business, which of the following costs must be paid by the farmer even if nothing is produced?

____a. both variable and fixed costs.
____b. variable cost.
____c. fixed costs.
____d. neither variable nor fixed costs.

QUESTION: (10) Based on the "Return Per $100 Investment" table below, a farmer with $1000 capital to invest in his farm business should invest the most in:

Returns Per $100 Investment

Capital	Bonds	Building	Machinery	Dairy Equipment
1st $100	$104	$155	$158	$170
2nd $100	104	148	143	160
3rd $100	104	136	139	151
4th $100	104	115	135	140
5th $100	104	100	130	136

____a. bonds.
____b. buildings.
____c. machinery.
____d. dairy equipment.

QUESTION: (11) A dairyman is milking an average of 40 head of dairy cows monthly and is not utilizing his good hired man efficiently during the winter. He has a large poultry house which is not being used presently and has, also, a surplus of corn. What should he do?

____a. expand his dairy herd.
____b. custom hire his corn production.
____c. buy 50 to 100 feeder pigs in late fall to feed out each winter.
____d. sell the surplus corn and let the hired man rest some in the winter.

QUESTION: (12) With limited capital, a farm operator would tend to invest his available capital in:

____a. long-term land improvements.
____b. quick turnover operations.
____c. new machinery and equipment.
____d. labor saving equipment.

QUESTION: (13) With a capital investment of $5000, a farmer could install an automatic feeding system for his dairy cows. It is estimated that this system would save approximately 300 hours of chore labor per year. In order for the farmer to make a sound decision on whether or not to invest in this system, he would need to consider which of the following:

____a. the possible return on the $5000 if invested elsewhere in the farm business.
____b. whether the labor saved could be profitably utilized elsewhere in the farm business.
____c. the annual fixed and variable costs for operating and maintaining the new feeding system.
____d. all of the above.

QUESTION: (14) A farmer has an average fixed cost of $12 per acre on land planted to corn. Assuming that the variable cost required to produce 1 bushel of corn remains the same, if the farmer increases corn production per acre, he will:

____a. lower the per bushel cost of producing corn.
____b. increase the per bushel cost of producing corn.
____c. not affect the per bushel cost of producing corn.
____d. decrease the variable costs per bushel of corn.

QUESTION: (15) A farmer has $1600 to invest in his farm business. He is presently raising 100 acres of small grain and has been harvesting with his own combine but the combine needs to be replaced. The cost of harvesting with his own combine is $3 per acre while custom combining costs $4 per acre. He can save $100 each year by doing his own combining. If the present combine can be replaced for $1600, the $100 saved by doing his own harvesting is about 6% return on his investment. If the $1600 were invested in dairy cows, it would return $200 above costs; what should the farmer do?

____a. replace the combine and continue harvesting small grain because he saves $100 per year.
____b. invest the money in dairy cows and hire the combining done.
____c. plant more acres of small grain in order to reduce fixed costs on the combine.
____d. invest in a smaller combine which would still get the harvesting done efficiently.

QUESTION: (16) A supplementary enterprise such as hogs following steers in a feed lot does:

____a. compete with another enterprise but also adds directly to the production of that enterprise.
____b. compete with other enterprises without adding to their production.
____c. add directly to the productivity of another enterprise.
____d. neither compete with nor add to the production of another enterprise, yet increases the net farm income.

QUESTION: (17) Whether or not a farm operator should adopt a soil improvement plan requiring an immediate large outlay of capital in order to insure a higher income in 5 years will depend upon:

____a. the present need for income.
____b. the current rate of interest on borrowed money.
____c. the potential for increasing his farm output.
____d. all of the above.

QUESTION: (18) Feeding trials have indicated that the first 50# of pork can be produced with 150# of feed; the second 50# of pork with 200# of feed; and the third 50# of pork with 275# of feed. Therefore, a farmer who feeds out hogs:

____a. can expect less added gain from each additional pound of feed fed to hogs being fattened.
____b. can expect more feed efficiency as hogs approach market weight.
____c. can produce the fourth 50# of pork for 300# of feed.
____d. can expect all of the above.

QUESTION: (19) When a farmer increases his investment in land, buildings, and equipment without increasing the total units of production, the cost per unit of production:

____a. decreases.
____b. increases.
____c. remains the same.
____d. varies with the operator.

QUESTION: (20) Based on the "Return to Investment" table below, if a farmer had $400 to invest in his present farming business, how much should he invest in machinery for maximum net farm income?

Returns Per $100 Investment

Capital	Hog Equipment	Machinery	Dairy Cows
1st $100	$155	$158	$170
2nd $100	148	143	160
3rd $100	136	139	151
4th $100	115	135	140

____a. $100
____b. $200
____c. $300
____d. $400

QUESTION: (21) Competing enterprises are those which compete with one another for the use of a farmer's resources; if one enterprise is increased, the other enterprise decreases. Therefore, all enterprises:

____a. become competitive at some point.
____b. never become completely competitive.
____c. become helpful to each other at some point.
____d. should be considered as separate business ventures.

QUESTION: (22) A particular farm has a 25-acre woodlot with a good stand of young trees. To insure optimum growth, a capital investment of $20 per acre is required to improve the woodlot. Which of the following operators should invest the necessary capital in this enterprise?

____a. an elderly operator with ample capital.
____b. a fairly young operator with ample capital.
____c. an operator with other enterprises which will pay 10% return on investment.
____d. a young operator with a need for a quick return.

QUESTION: (23) An 8# ration of cracked corn and sufficient roughage and protein supplement fed daily to an 800# steer will yield a 2# daily gain in weight. If the amount of cracked corn is increased to 16# per day with sufficient roughage and protein supplement added to balance the ration, the daily gain will now most likely be:

____a. twice that of the 8# ration of cracked corn.
____b. less than the 8# ration of cracked corn.
____c. more than the 8# ration of cracked corn.
____d. more than twice that of the 8# ration of cracked corn.

QUESTION: (24) To secure maximum profit through increased milk production, a dairyman should increase the daily ration fed dairy cows until the cost of the additional feed is:

____a. greater than the value of the increased milk production.
____b. less than the value of the increased milk production.
____c. equal to the value of the increased milk production.
____d. one-half the value of the increased milk production.

QUESTION: (25) If 1# of soybean meal will substitute for 1.2# of linseed meal of equal nutritional value and soybean meal sells for 5.2¢ per pound and linseed meal sells for 4¢ per pound, the livestock farmer who wishes to make the largest net income should:

____a. feed 68% soybean meal and 32% linseed meal.
____b. feed all soybean meal.
____c. feed 20% soybean meal and 80% linseed meal.
____d. feed all linseed meal.

QUESTION: (26) A farmer's profit will be greatest if each unit of land, labor, and capital is used:

____a. in such a manner that it will add the most to gross returns of the farm business.
____b. on the enterprise in which the farmer has the greatest interest and ability.
____c. on the enterprises where he will realize the greatest yield per acre or animal unit.
____d. in such a manner that will add the most to net returns of the farm business.

QUESTION: (27) Combining crop enterprises to reduce uncertainty is advantageous particularly for:

____a. the beginning farmer with ample capital.
____b. a tenant farmer with specialized machinery.
____c. a farmer with unlimited capital.
____d. a farmer with limited capital.

QUESTION: (28) A 4-plow gasoline tractor burns 4 gallons of fuel per hour, and a 4-plow diesel tractor burns 3 gallons of fuel per hour. A farmer should consider purchasing a diesel tractor if:

____a. the annual fuel costs are less for the diesel.
____b. the annual savings in fuel costs will be more than the additional annual cost of owning the diesel tractor.
____c. the annual savings in fuel costs will equal the total costs incurred in owning the gasoline tractor.
____d. the rate of operation per acre is the same with the diesel as the rate for the gasoline tractor.

QUESTION: (29) A farmer has been feeding cattle on his 300-acre farm since 1955 with the help of an up-to-date set of machinery and a good full-time hired man. He has always fed out 75 head of calves and 50 head of yearlings per year. Over the last 5 years he has invested $15,000 in his cattle feeding operation for buildings and modern feeding equipment. His net income has decreased even with the addition of efficient feeding facilities and he cannot understand why. Can you explain the reason?

____a. cattle feeders can expect losses for several years in a row.
____b. he should have fed out all yearlings.
____c. he has increased overhead costs without changing his volume of business.
____d. he made the wrong choice of enterprises as dairying is a better enterprise.

QUESTION: (30) By diversifying crop enterprises rather than specializing in one major crop, the crop farmer will:

____a. reduce risk and uncertainty.
____b. decrease annual labor efficiency.
____c. facilitate the use of more labor saving equipment.
____d. concentrate production knowledge.

QUESTION: (31) In your judgment, which of the following farm operators would be more inclined to invest in a long-range soil conservation plan?

____a. a beginning farmer who is short on capital.
____b. a tenant with a long-term lease.
____c. an owner-operator with money in a savings account.
____d. an owner-operator who is heavily in debt.

QUESTION: (32) Assuming all other production factors are of no influence, the fertility of a given field is sufficient to produce 80 bushels of corn per acre without additional nitrogen. The addition of 10# of available nitrogen to one acre of the above land will increase the yield 10 bushels per acre. If a second 10# of available nitrogen is applied to the same land, the yield per acre will most likely:

____a. increase the same number of bushels per acre as the first 10# of available nitrogen applied.
____b. increase less bushels per acre than the first 10# of available nitrogen applied.
____c. increase more bushels per acre than the first 10# of available nitrogen applied.
____d. not be affected by the additional 10# of available nitrogen applied.

QUESTION: (33) A beginning farmer with limited capital in the amount of $3000 has had to make a choice between the following two alternatives: (1) purchase a new combine (estimated life 10 years) for $3000 or (2) purchase a used combine for $1600 (estimated life 6-7 years) and have $1400 to invest in needed lime and fertilizer. He decided to buy the used combine and have the $1400 for other production uses on the farm. He made the correct decision. Why did he make the correct decision?

____a. the annual savings in fixed costs on the used combine will be enough to replace the machine when it wears out.
____b. the added net return from the expenditure for lime and fertilizer will provide sufficient money to replace the machine when it wears out.
____c. the return on investment is higher on the used combine than on the new combine.
____d. beginning farmers have the tendency to "over invest" in machinery and "under invest" in other production resources.

QUESTION: (34) Based on the table below showing the yield at different levels of nitrogen used per acre of wheat, which statement is most nearly correct?

No. of Lbs. of Nitrogen Added	Total Yield Per Acre
0	30 bushels
10	38 bushels
20	42 bushels
30	44 bushels
40	45 bushels

____a. the bushels added to the total yield by each successive 10# of additional nitrogen increase at a uniform rate.
____b. the bushels added to the total yield by each successive 10# of additional nitrogen increase at a diminishing rate.
____c. the bushels added to the total yield are greatest at the 20# level.
____d. the 40# rate will yield the best return on a farmer's investment in fertilizer.

QUESTION: (35) Commercial fertilizer should be applied to crops as long as:

____a. the added production returns increase gross farm income.
____b. the added fertilizer maintains soil productivity.
____c. the added production returns are more than the added cost of the fertilizer.
____d. the added fertilizer increases crop yields per acre.

QUESTION: (36) An approved practice for increasing the per acre yield of soybeans has been discovered and tested at the State Experimental Station. A farmer should adopt the new practice if:

____a. it will improve the quality of soybeans.
____b. it will increase soybean receipts more than expenses.
____c. it will increase the size or volume of the farm business.
____d. it will increase gross farm income.

QUESTION: (37) For maximum net returns, a farmer should substitute machinery for labor when:

____a. the annual cost of machine use is equal to the cost of labor.
____b. the value of labor saved is more than the annual cost of machine use.
____c. there is a limited supply of labor.
____d. the additional machine will increase labor efficiency.

QUESTION: (38) In analyzing the farm business, depreciation should be considered as:

____a. a variable cost.
____b. a fixed cost.
____c. an opportunity cost.
____d. an operating cost.

QUESTION: (39) A farmer can borrow only $400 for chemicals to control weeds on 100 acres of corn, 100 acres of wheat, and 100 acres of barley. Previous weed control trials have indicated that he can expect the following returns per $1 invested in chemicals:

Return Per Additional $1 of Chemicals

	Corn	Wheat	Barley
1st $100	$2.50	$1.50	$1.25
2nd $100	2.25	1.25	1.00
3rd $100	1.75	.75	.50
4th $100	1.25	.50	.25

He should:

____a. put all $400 worth on corn.
____b. put $300 on corn and $100 on wheat.
____c. put $200 on corn and $200 on wheat.
____d. distribute it evenly over all these crops.

QUESTION: (40) A dairy man is milking 50 Holstein cows with a yearly milk production record of 8000# per cow. He has $10,000 capital to invest in his dairy enterprise. He has had to make a choice between the following alternatives: (1) invest $10,000 in an ultra-modern feeding system, or (2) invest $6000 in a "conventional type" feeding system and have $4000 to invest in higher producing cows. He decided to invest the $10,000 in the modern feeding system. He made the wrong decision. Why?

____a. the annual depreciation charge is more than he can profitably afford.
____b. $10,000 is too much to invest in buildings and equipment for 50 cows.
____c. the added returns from the investment in high producing cows would have yielded more profit to the farmer in the long run than the new feeding system.
____d. his neighbors think he made a mistake.

QUESTION: (41) The normal seeding rate for barley is 90# per acre. Two fields with comparable capability and fertility levels are seeded to barley. Field "A" is seeded at the rate of 115# per acre and Field "B" is seeded at the rate of 140# per acre. Assuming that growing conditions were identical for each field, we might predict that the yield per acre of Field "B" would be:

____a. twice the yield of Field "A".
____b. the same yield as Field "A".
____c. less than the yield of Field "A".
____d. more than the yield of Field "A".

QUESTION: (42) It is profitable for a farmer to borrow money to expand his farm business when the borrowed money:

____a. returns more than the cost of borrowing money.
____b. can be secured at a low interest rate.
____c. can improve the level of production.
____d. will increase volume of business.

QUESTION: (43) A hog raiser should substitute barley for corn in a ration as long as:

____a. barley is 80¢ per bushel and corn is $1 per bushel.
____b. barley and corn substitute at the same rate of total digestible nutrients.
____c. the value of the corn replaced is less than the cost of the barley added.
____d. the value of the corn replaced is more than the cost of the barley added.

QUESTION: (44) In the long run, usually 15-20 years, all costs encountered in operating a farm business become:

____a. variable costs.
____b. fixed costs.
____c. submarginal.
____d. capital costs.

QUESTION: (45) Assuming that a farmer is efficiently managing his farm business, the last dollar spent on a factor of production, such as seed, fertilizer, machinery, or buildings, will yield a marginal or added return:

____a. greater than the last dollar earned from all other factors of production.
____b. exactly equal to the last dollar earned from all other factors of production.
____c. less than the last dollar earned from all other factors of production.
____d. twice as large as the last dollar earned from all other factors of production.

NUMBERS OF QUESTIONS APPEARING IN THE POST-TEST DEALING WITH SPECIFIC INSTRUCTIONAL UNITS AND PROFIT-MAXIMIZING PRINCIPLES

Instructional Unit	Profit-Maximizing Principle	Numbers of the Questions
1	Diminishing physical returns	1 - 18 - 23 32 - 34 - 41
2	Diminishing economic returns	2 - 7 - 24 - 35 36 - 42
3	Fixed-variable costs	4 - 9 - 14 - 19 29 - 38 - 44
4	Substitution	3 - 8 - 13 - 25 28 - 37 - 43
5	Opportunity costs	5 - 10 - 15 20 - 26 - 39 45
6	Combination of enterprises	6 - 11 - 16 21 - 27 - 30
7	Time comparisons	12 - 17 - 22 31 - 33 - 40

PROFIT-MAXIMIZING PRINCIPLES RESEARCH PROJECT
Tabulation Sheet

Name of School______________________
County________________ District_____
Control (1), Pilot-Block (2) Pilot-Integrated (3): Specify____________
Class(es) in project: (Ag. III and IV, Ag. III, Ag. IV) Circle.
Total Number Students in Project______
Vocational Agriculture Enrollment_____
Total School Enrollment_______________

Name of Vo-Ag Teacher in Charge of this Project___________________
Years of Teaching Experience_____ Quarter hours of Agr. Economics__________
Quarter hours of Economics__________
Conducted Farm Business Planning and Analysis Classes: Yes_____ No________
Received Organized Instruction in Farm Business Planning and Analysis in Agricultural Education 709_________ Agricultural Education 799B________
Number of Teachers in Vo-Ag Department__________
Total Number of Hours of Instructional Time Used on Project_______________
Advanced Degree: Yes__________ No__________

Name of Student (Grouped by Class)	Do Not Write Here	Year In Vo-Ag	Year In High School	Years of Actual Farm Experience (Fresh. 1, Soph. 2, Jrs. 3, Srs. 4)	Current or Previous Economics In High S. Yes - No	School Records - Specify Mental Maturity, I.Q., etc.		Post Test Score
						Type:________ (Score)	Type:________ (Score)	

PROFIT-MAXIMIZING PRINCIPLES RESEARCH PROJECT
Daily Schedule of Activities

NOTE: Please indicate below the title of the subject matter covered this week in relation to your class of vocational agriculture involved in the economic principles project. Note any problems, questions, or suggestions that you have that might be helpful for the improvement of this project.

Please mail your completed copy each Friday to Richard L. Barker, Room 202, Agricultural Administration Building, 2120 Fyffe Road, Ohio State University, Columbus, Ohio 43210.

Week of ______________________

Monday

Tuesday

Wednesday

Thursday

Friday

Comments

School______________________

Teacher______________________

APPENDIX F

RELATED DATA

MATRIX OF INSTRUCTIONAL PERIODS, OBSERVATION VISITS, AND TESTING DATES

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School   Dates - Week of:

         October    November     December  January         February     March
         17 24 31   7 14 21 28   5 12 19   2 9 16 23 30    6 13 20 27   6 13

    1                                              --#------------- *
    2         -----------------------------#-----------*
    3                                              --#--------- *
    4                                           -------#-------------   *
    5    ----------------#----             ------------*
    6                                              -----------#------------*

    7         ------------#----------*
    8    -----------#----  *
    9         ---------#--------  *
   10      ------------#----------*
   11    -------------------#---  -------------*
   12              ------------      ---#---- *
   13                       ----- ------#---------------   *

   14             ----------    --------#------*
   15                              --- ----- -#----   --------  *
   16                                       -----            ---#-----------*
   17             ----          ----           --#-         ----       --*
   18                              -------   -#-                -------*
   19    -----------#-------                         -----------------*
   20                                       ----------------#------- *
   21                        -----------#------ *
   22                     --------------    ---#---*
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Key:

```
----  Instructional period
   #  Observation visit
   *  Post-test administered
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POST-TEST SCORES FOR ALL PARTICIPATING SCHOOLS

School No.	No. of Students	Post-Test Scores
Control:		
1	5	63.6
2	17	49.5
3	12	50.7
4	20	58.7
5	7	50.5
6	16	53.8
Sub-Total	77	54.0
Pilot-Block:		
7	12	59.1
8	7	62.9
9	19	56.3
10	11	60.6
11	11	57.6
12	13	75.4
13	4	56.7
Sub-Total	77	61.3
Pilot-Integrated:		
14	14	50.6
15	14	68.1
16	9	57.8
17	8	39.4
18	10	53.1
19	15	66.4
20	11	45.5
21	7	64.4
22	20	67.1
Sub-Total	108	58.4
Grand Total	262	58.0

CORRELATIONS BETWEEN INDEPENDENT VARIABLES AND TOTAL POST-TEST SCORES FOR ALL PARTICIPATING GROUPS OF SCHOOLS[1]

	Participating Groups of Schools			
Independent Variables	Control	Pilot-Block	Pilot-Integrated	Total
Student year in vocational agriculture	.121	.182	.325[b]	.257[b]
Student year in high school	-.026	.237[a]	.159	.180
Student years of farm experience	.264[a]	.251[a]	.293[b]	.297[b]
Student I.Q.	.535[b]	.737[b]	.593[b]	.624[b]
Economics courses taken by student in high school	-.201	.117	-.058	-.038
Number of teachers in Vo-Ag department	.267[a]	.217	.054	.166
College quarter hours of economics instruction received by the teacher	.136	-.278[a]	.086	.075
Teacher having received FBPA instruction	.077	-.068	.001	-.027
Teacher having coordinated an FBPA program	.128	.000[c]	-.024	-.026
Teacher's years of teaching experience	-.167	-.227	-.293[b]	-.240[a]
Teacher's attainment of an advanced degree	-.053	.176	-.274[b]	-.044
Hours of instructional time used	-.159	-.108	.266[b]	-.043
Local grades	.128	.284[a]	.067	.091

[1] Pearson Product-Moment Correlation Coefficient r.

[a] Significant at .05 level.

[b] Significant at .01 level.

[c] Not defined due to lack of comparison.

CORRELATIONS BETWEEN INDEPENDENT VARIABLES AND POST-TEST SCORES CONCERNING EACH INSTRUCTIONAL UNIT FOR CONTROL SCHOOLS[1]

Independent Variable	Instructional Unit						
	1	2	3	4	5	6	7
Student year in Vo-Ag. . . .	.014	.023	.225	.194	-.051	.029	.076
Student year in high school .	.075	.041	-.056	.098	.063	-.087	-.075
Student years of farm experience . .	.027	.071	.294[a]	.339[b]	.161	.076	.214
Student I.Q. .	.320[b]	.249[a]	.362[b]	.548[b]	.480[b]	.285[a]	.216
Economics taken by students in high school . . .	-.137	-.140	-.212	-.073	-.054	-.282[a]	-.072
Number of teachers in Vo-Ag. Dept.	.300[a]	.154	.172	.070	.144	.274[a]	.213
College quarter hours of economics instruction received by the teacher . . .	.246[a]	.179	.069	.014	.066	.059	.045
Teacher having received FBPA instruction .	.267[a]	.056	-.004	.004	.092	-.092	.086
Teacher having coordinated FBPA program	.272[a]	.094	.118	-.066	.056	.077	.138
Teacher's years of teaching experience .	-.241[a]	-.139	-.141	.009	-.072	-.166	-.103
Teacher's attainment of an advanced degree . . .	-.003	-.040	-.129	.074	.038	-.179	-.054
Hours of instructional time used . .	-.003	-.098	-.146	-.075	-.042	-.323[b]	-.068

CORRELATIONS BETWEEN INDEPENDENT VARIABLES AND POST-TEST SCORES CONCERNING EACH INSTRUCTIONAL UNIT FOR CONTROL SCHOOLS[1]--Continued

Independent Variable	Instructional Unit						
	1	2	3	4	5	6	7
Local grades . .	.483[b]	.442[b]	.510[b]	.486[b]	.243[a]	.474[b]	.232

[1] Pearson Product-Moment Correlation Coefficient r.

[a] Significant at .05 level.

[b] Significant at .01 level.

CORRELATIONS BETWEEN INDEPENDENT VARIABLES AND POST-TEST SCORES CONCERNING EACH INSTRUCTIONAL UNIT FOR PILOT-BLOCK SCHOOLS[1]

Independent Variable	Instructional Unit						
	1	2	3	4	5	6	7
Student year in Vo-Ag.	-.021	.156	.181	.128	.248[a]	.118	.133
Student year in high school	.123	.288[a]	.139	.101	.246[a]	.104	.228
Student years of farm experience	.083	.235[a]	.172	.274[a]	.220	.125	.166
Student I.Q.	.516[b]	.499[b]	.630[b]	.613[b]	.475[b]	.548[b]	.513[b]
Economics taken by students in high school	.161	.122	.102	.095	.142	.034	-.089
Number of teachers in Vo-Ag. Dept.	.192	.289[a]	.098	-.007	.167	.260[a]	.137
College quarter hours of economics instruction received by the teacher	-.163	-.173	-.266[a]	-.215	-.227	-.220	-.170
Teacher having received FBPA instruction	.008	.014	-.012	-.078	.022	-.123	-.210
Teacher having coordinated FBPA program	Not defined due to lack of comparison.						
Teacher's years of teaching experience	-.151	-.173	-.201	-.126	-.250[a]	-.183	-.081
Teacher's attainment of an advanced degree	.225	.244[a]	-.023	.028	.088	.141	.213
Hours of instructional time used	-.093	-.263[a]	-.037	.109	-.042	-.175	-.076

CORRELATIONS BETWEEN INDEPENDENT VARIABLES AND POST-TEST SCORES CONCERNING EACH INSTRUCTIONAL UNIT FOR PILOT-BLOCK SCHOOLS[1]--Continued

Independent Variable	Instructional Unit						
	1	2	3	4	5	6	7
Local grades . .	.527[b]	.748[b]	.711[b]	.542[b]	.450[b]	.232	.201

[1] Pearson Product-Moment Correlation Coefficient r.

[a] Significant at .05 level.

[b] Significant at .01 level.

CORRELATIONS BETWEEN INDEPENDENT VARIABLES AND POST-TEST SCORES CONCERNING EACH INSTRUCTIONAL UNIT FOR PILOT-INTEGRATED SCHOOLS[1]

Independent Variable	Instructional Unit 1	2	3	4	5	6	7
Student year in Vo-Ag. . . .	.201	.175	.341	.189	.267	.131	.312
Student year in high school .	.059	.094	.086	.148	.148	-.003	.270
Student years of farm experience . .	.267[b]	.176	.231	.178	.234	.109	.264
Student I.Q. .	.458[b]	.455[b]	.260[b]	.582[b]	.316[b]	.503[b]	.388[b]
Economics taken by students in high school	-.004	-.174	-.004	.004	-.085	-.120	.063
Number of teachers in Vo-Ag. Dept.	.120	.086	.026	-.032	.067	-.026	.040
College quarter hours of economics instruction received by the teacher . . .	.128	.050	.089	.098	.012	-.026	.037
Teacher having received FBPA instruction .	.092	.015	.046	-.074	-.019	-.067	.012
Teacher having coordinated FBPA program	.032	-.001	-.054	-.139	.065	.001	-.010
Teacher's years of teaching experience .	-.278[b]	-.199[a]	-.332	-.176	-.138	-.169	-.157
Teacher's attainment of an advanced degree . . .	-.249	-.170	-.282	-.233	-.249	-.054	-.114
Hours of instructional time used . .	.155	.212[a]	.210[a]	.179	.269	.207	.102

CORRELATIONS BETWEEN INDEPENDENT VARIABLES AND POST-TEST SCORES CONCERNING EACH INSTRUCTIONAL UNIT FOR PILOT-INTEGRATED SCHOOLS[1]--Continued

Independent Variable	Instructional Unit 1	2	3	4	5	6	7
Local grades . .	.354[b]	.506[b]	.415[b]	.515[b]	.464[b]	.420[b]	.251[a]

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[1] Pearson Product-Moment Correlation Coefficient r.

[a] Significant at .05 level.

[b] Significant at .01 level.

CORRELATIONS BETWEEN INDEPENDENT VARIABLES AND POST-TEST SCORES CONCERNING EACH INSTRUCTIONAL UNIT FOR ALL SCHOOLS[1]

Independent Variable	Instructional Unit 1	2	3	4	5	6	7
Student year in Vo-Ag. . . .	.128	.154	$.286^{b}$	$.206^{a}$	$.209^{a}$	.112	.181
Student year in high school .	.093	.169	.094	.167	$.208^{a}$	.026	.134
Student years of farm experience . .	.190	.192	$.256^{b}$	$.280^{b}$	$.237^{a}$	.114	$.205^{a}$
Student I.Q. .	$.445^{b}$	$.413^{b}$	$.398^{b}$	$.576^{b}$	$.409^{b}$	$.461^{b}$	$.375^{b}$
Economics taken by student in high school .	.016	-.080	-.029	.013	-.002	-.110	.008
Number of teachers in Vo-Ag. Dept.	.181	.178	.099	.011	.099	.152	.129
College quarter hours of economics instruction received by the teacher . . .	.126	.102	.054	.091	.056	-.024	-.052
Teacher having received FBPA instruction .	.081	-.005	-.003	-.078	-.006	-.098	-.017
Teacher having coordinated FBPA program	.045	-.032	-.036	-.140	.002	.005	.054
Teacher's years of teaching experience .	$-.238^{a}$	$-.196^{a}$	$-.212^{a}$	-.127	$-.197^{a}$	-.164	-.057
Teacher's attainment of an advanced degree . . .	-.015	.039	-.136	-.030	-.049	-.018	-.002
Hours of instructional time used . .	-.010	-.075	-.032	-.037	.008	-.093	.029

CORRELATIONS BETWEEN INDEPENDENT VARIABLES AND POST-TEST SCORES CONCERNING EACH INSTRUCTIONAL UNIT FOR ALL SCHOOLS[1]--Continued

Independent Variable	Instructional Unit						
	1	2	3	4	5	6	7
Local grades . .	.400[b]	.464[b]	.479[b]	.434[b]	.373[b]	.255[a]	.105

[1] Pearson Product-Moment Correlation Coefficient r.

[a] Significant at .05 level.

[b] Significant at .01 level.

PERCENTAGE OF CORRECT RESPONSES TO EACH POST-TEST QUESTION BY GROUPS OF STUDENTS

Question Number	Control (n=77)	Pilot-Block (n=77)	Pilot-Integrated (n=108)	Total (n=262)
1	77	86	79	81
2	53	57	49	53
3	57	65	66	63
4	65	65	59	63
5	29	43	41	38
6	22	33	43	34
7	68	70	60	66
8	64	69	77	71
9	47	57	56	54
10	74	84	77	79
11	62	66	62	63
12	61	65	52	59
13	79	83	81	81
14	48	56	44	48
15	58	60	71	65
16	52	55	47	51
17	77	74	73	74
18	51	57	58	56
19	62	62	64	64
20	40	51	53	48
21	47	49	48	48
22	73	62	55	62
23	69	70	69	69
24	21	40	33	31
25	29	47	32	34
26	56	70	60	62
27	60	66	62	63
28	52	64	70	63
29	92	91	85	89
30	77	74	72	74
31	57	62	63	60
32	47	70	71	63
33	61	48	62	58
34	48	73	62	62
35	48	77	64	62

PERCENTAGE OF CORRECT RESPONSES TO EACH POST-TEST QUESTION BY GROUPS OF STUDENTS--Continued

Question Number	Control (n=77)	Pilot-Block (n=77)	Pilot-Integrated (n=108)	Total (n=262)
36	52	62	61	59
37	47	69	58	57
38	42	66	56	55
39	29	35	52	36
40	82	77	75	77
41	60	55	52	54
42	58	68	75	68
43	42	57	42	45
44	22	34	33	31
45	16	18	20	17
Mean	54.0	61.4	58.5	58.0

APPENDIX G

TEACHER EVALUATION OF THE INSTRUCTIONAL UNITS

January 26, 1967

To: Teachers of pilot schools involved in the Profit-Maximizing Principles Research Project.

From: Floyd G. McCormick and Richard L. Barker

We are very pleased with the progress of the Profit-Maximizing Principles Research Project and the support you have given to it. Your continued cooperation is appreciated!

Due to recent changes in the status of the project here in Columbus, it is necessary to accelerate the revision of the seven instructional units. To accomplish this task we need the assistance of all teachers who have or are still using the units. Previously we had tentatively planned to meet at Lucas and Jackson Center in late March, but now it becomes imperative to move this meeting up to February. We would be most appreciative if you could all meet with us at the Agricultural Administration Building on February 17, 18, or 22, for three or four hours. The purpose of this evaluation meeting will be to review together the strengths and weaknesses of the individual instructional units and to make suggestions for their improvement so that other teachers may benefit from them.

Would you please select a date on the enclosed form--one that best meets with your schedule for a joint meeting. From the suggested list a date will be selected that best meets with the approval of the majority of the teachers involved.

Would you also complete the questions on the same enclosed form. They will assist in the acceleration of the efforts of the above meeting. Please send this with your choice of date in the return mail.

/rmb

Enclosure

P.S. You may have developed visual aids, tests, handouts, etc. that might be helpful in revising the manual. If so, would you kindly share them with the group at this meeting?

EVALUATION MEETING

The following dates and time for the project evaluation meeting best coincide with my schedule: (please check one)

_____Friday, February 17, 1967
_____Saturday, February 18, 1967
_____Wednesday, February 22, 1967

Best time to hold meeting: _______________.

Teacher Impressions -- of the "Instructional Units on Profit-Maximizing Principles" Manual.

1. Generally, the contents of this manual (should_____, should not_____) be used in vocational agriculture.

2. Do you feel that you would be interested in participating in this project another year?

3. Without being involved in a testing program, but supplied with the manual, would you use the instructional units another year? Yes_____ No_____. How?

4. List the two greatest problems you had in using the manual.
   (a)

   (b)

5. List the two greatest difficulties with the approach to teaching used in this manual.
   (a)

   (b)

Teacher Impressions--Page 2

6. List the two greatest weaknesses you found with the contents of this manual.
   (a)

   (b)

7. List the two greatest strengths you found with the contents of this manual.
   (a)

   (b)

8. List the major changes or revisions you believe necessary to make the instructional units more applicable to vocational agriculture in Ohio.
   (a)

   (b)

   (c)

   (d)

9. In addition to the above suggestions, what additional aids, items, or information would be helpful to you to be included with the revised copy?
   (a)

   (b)

   (c)

   (d)

10. Other comments:

Summary of:

TEACHER IMPRESSIONS--of the Instructional Units on Profit-Maximizing Principles

I. Generally the contents of this manual (should 11 , should not 1) be used in vocational agriculture.

II. Do you feel that you would be interested in participating in this project another year?
Answers: Yes - 7; In 1968-69 - 2; Questionable - 3.

III. Without being involved in a testing program, but supplied with the manual, would you use the instructional units another year?
Answer: Yes - 12. How?

A. As a teacher reference.
B. Combine with other material in farm management.
C. Integrate with FBPA with senior class each year.
D. As a part of crops and soils management.
E. Integrate with marketing.
F. Correlate with selection of dairy, beef, and swine rations.

In analyzing the remainder of the remarks made by teachers in evaluating the units, their comments were classified into the areas of (a) teacher-centered problems, (b) student-centered problems, (c) unit-centered weaknesses, (d) unit-centered strenghts, and (e) additions needed.

IV. Teacher-Centered Problems:

A. Getting time to study units myself.
B. My ignorance.
C. My ability to apply the principle in a simple form.
D. There may be a tendency of not relating the principles' approach to the practical application.
E. Tendency for teacher to use without considerable preparation.
F. Hard to see that I was getting anywhere.
G. Difficult to motivate students without a definite goal to work toward.
H. Arriving at conclusions as in the manual.
I. Making student worksheets.
J. Preparation of visual aids.
K. Testing students.
L. Some formulas are hard to understand without the use of the text.

M. Getting the material condensed to what I wanted to use.
N. A teacher workshop is needed to explain the desirable use of the materials.

V. Student-Centered Problems:

A. Many times the students don't see any relationship of the materials to their own personal situations.
B. Most examples are brought to the level of the boys on situations they know about.
C. Holding student interest.
D. Students learn to think.

VI. Unit-Centered Weaknesses:

A. Time consuming.
B. Examples should be related to students more.
C. Clarification of examples and points.
D. Some examples are not related to agriculture.
E. Introductory examples don't seem to fit any class.
F. Livestock examples are more difficult to understand.
G. Too many examples.
H. At the beginning I felt that there were too many examples.
I. Applying materials to student situations and ability.
J. The brighter boys grasp the entire thought before the others have the pizza eaten.
K. The time comparison principle needs more explanation. (It gave me the most trouble and the students enjoyed it the most.)
L. Slanted toward post-high school level.
M. Too voluminous.
N. Too much repetition.
O. A little more detail than necessary.
P. Lack of problems in some units that students can work out.
Q. Some charts could be more specific and up to date with actual and current figures and prices.
R. Some areas don't seem practical or usable.

VII. Unit-Centered Strengths:

A. Easily and quickly read.
B. Follows logical sequence from simple to complex.
C. Well organized into chapters.
D. Clear statement of principle to be studied.
E. List of objectives at the beginning of each unit which serves as a guide in determining major points.
F. Approach and introduction to each unit.
G. Many good examples.
H. Illustrated material.
I. The use of charts and graphs. This gives students an opportunity to learn to use them.

J. Information relates to boys' situations.
K. Use of actual student experiences.

VIII. Additions Needed:

A. Charts and tables should be on separate pages for ease of reproduction.
B. Loose-leaf binder should be used.
C. Combine first two units.
D. Teacher's handbook needed.
E. Prepare student problems, work units, work sheets, and/or workbook.
F. More student activities after each unit.
G. Student text materials.
H. Unit tests needed.
I. Tie units in with such areas of study as marketing.
J. More relationship to agri-business. Use examples along this line.
K. Cover more area with charts and examples.
L. More practical, specific, and usable facts and examples that are more closely related to student projects.

APPENDIX H

DATA PROCESSING

CODING SHEET FOR PROFIT-MAXIMIZING PRINCIPLES RESEARCH PROJECT

01 02 03 04   05 06 07 08   09 10 11 12   13 14 15 16   17 18 19 20

21 22 23 24   25 26 27 28   29 30 31 32   33 34 35 36   37 38 39 40

41 42 43 44   45 46 47 48   49 50 51 52   53 54 55 56   57 58 59 60

61 62 63 64   65 66 67 68   69 70 71 72   73 74 75 76   77 78 79 80

CODING MASTER

IBM Card Column No.	Data Coded
01-02	School number - 01 through 22
03	Type of school - 1, 2, or 3 1 - Control 2 - Pilot-Block 3 - Pilot-Integrated
04	Number of teachers in vocational agriculture department - 1 or 2
05-06	College quarter hours of economics instruction received by teacher
07	FBPA instruction received by teacher 0 = No 1 = Yes
08	FBPA program conducted by teacher 0 = No 1 = Yes

CODING MASTER--Continued

IBM Card Column No.	Data Coded
09-10	Teacher's years of teaching experience
11	Teacher's attainment of an advanced degree 0 = No 1 = Yes
13-14	Hours of instructional time used

15-16	Student number
17	Student year in vocational agriculture - 1 through 4
18	Student year in high school - 1 through 4
19	Student years of farm experience - 0 through 4
20	Student has taken economics courses in high school 0 = No 1 = Yes
21-22-23	Student I.Q.

24-68	Exam questions 1 to 45 1 = A 2 = B 3 = C 4 = D

76-77-78	Local grade
79-80	Teacher post-test score

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